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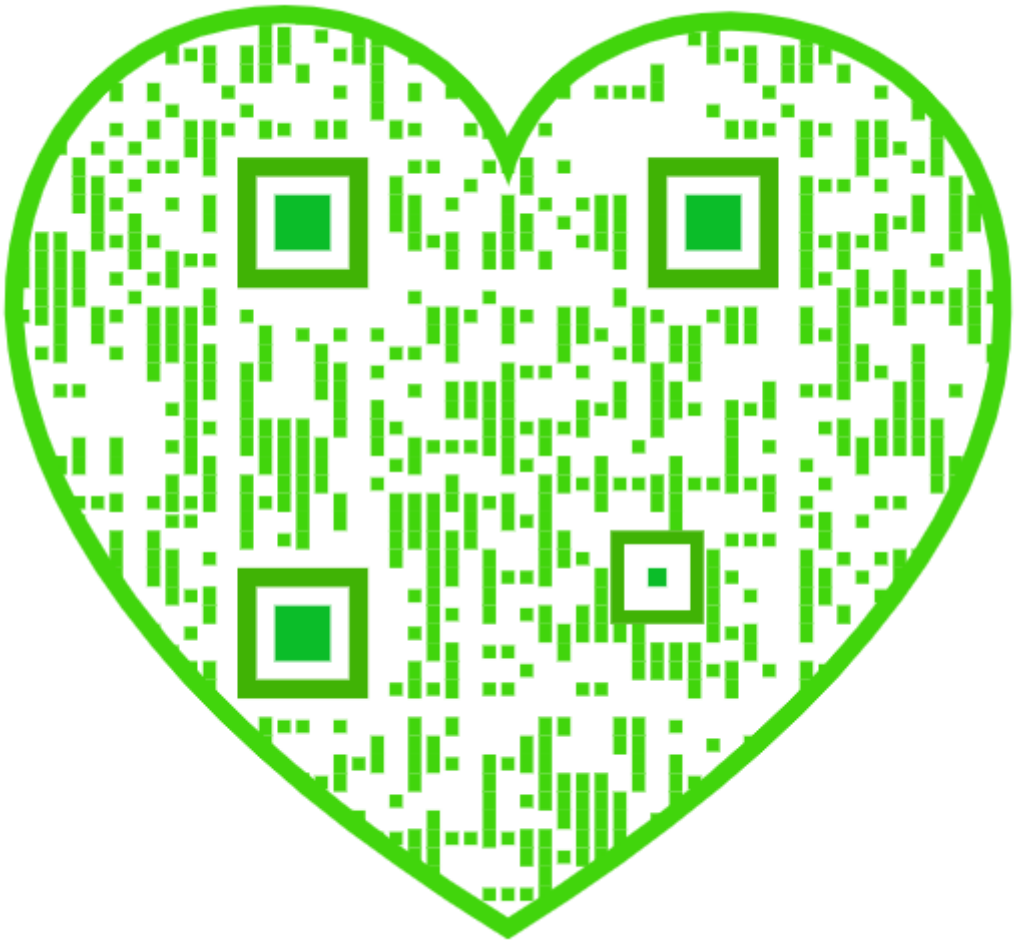
DCPA ATTACK ENVIRONMENT MANUAL

CHAPTER 8

WHAT THE PLANNER NEEDS TO KNOW ABOUT
THE POST-SHELTER ENVIRONMENT

DEFENSE CIVIL PREPAREDNESS AGENCY
DEPARTMENT OF DEFENSE

JUNE 1973



DCPA ATTACK ENVIRONMENT MANUAL

WHAT THE EMERGENCY PLANNER NEEDS TO KNOW ABOUT THE NATURE OF NUCLEAR WAR

No one has gone through a nuclear war. This means there aren't any natural experts. But civil defense officials are in the business of preparing against the possibility of nuclear war. Intelligent preparations should be based on a good understanding of the operating conditions that may occur in a war that has never occurred. Lacking such understanding, emergency operating plans probably won't make much sense if they have to be used.

This manual has been prepared to help the emergency planner understand what the next war may be like. It contains information gathered from two decades of study of the effects of nuclear weapons and the feasibility of civil defense actions, numerous operational studies and exercises, nuclear test experience, and limited experience in wartime and peacetime disasters that approximate some of the operating situations that may be experienced in a nuclear attack. In short, it summarizes what the Defense Civil Preparedness Agency now knows about the nuclear attack environment as it may affect operational readiness at the local level.

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PREFACE TO CHAPTER 8

This description of the post-shelter environment focuses on the barriers to well-being that must be coped with if nuclear emergency operations are to be fully effective. It presumes that the reader is familiar with the material in earlier chapters. The information presented, along with that in other chapters, is applied in Chapter 9 to the problem of contingency planning for nuclear emergencies. A secondary purpose of Chapter 8 is to introduce the planner to some of the technical basis for confidence that postattack recovery can be planned for.

Information is presented in the form of "panels," each consisting of a page of text and an associated sketch, photograph, chart, or other visual image. Each panel covers a topic. This preface is like a panel, with the list of topics in Chapter 8 shown opposite. If the graphic portion is converted into slides or vugraphs, the chapter or any part can be used in an illustrated lecture or briefing, should that be desired.

The first two panels present the general nature of the post-shelter problems that must be dealt with. The next two panels emphasize the importance of communications with the public, the emergency organization, and other governmental levels. Two panels discuss the operational limitations imposed by fallout and what can be done about it. Then three panels discuss the needs for life support, and three the needs for health and medical support. There follow two panels on restoring energy supplies and two on manpower needs. Five panels deal with restoring production and two with preventing longer-term injuries to the survivors and their habitat. Two panels are devoted to social and psychological aspects of recovery. The next four panels treat the special problems of recovery in damaged areas. Finally, the case for postattack recovery is summarized. A list of suggested additional reading is included for those who are interested in further information on the general subject.

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WILL SURVIVORS ENVY THE DEAD?

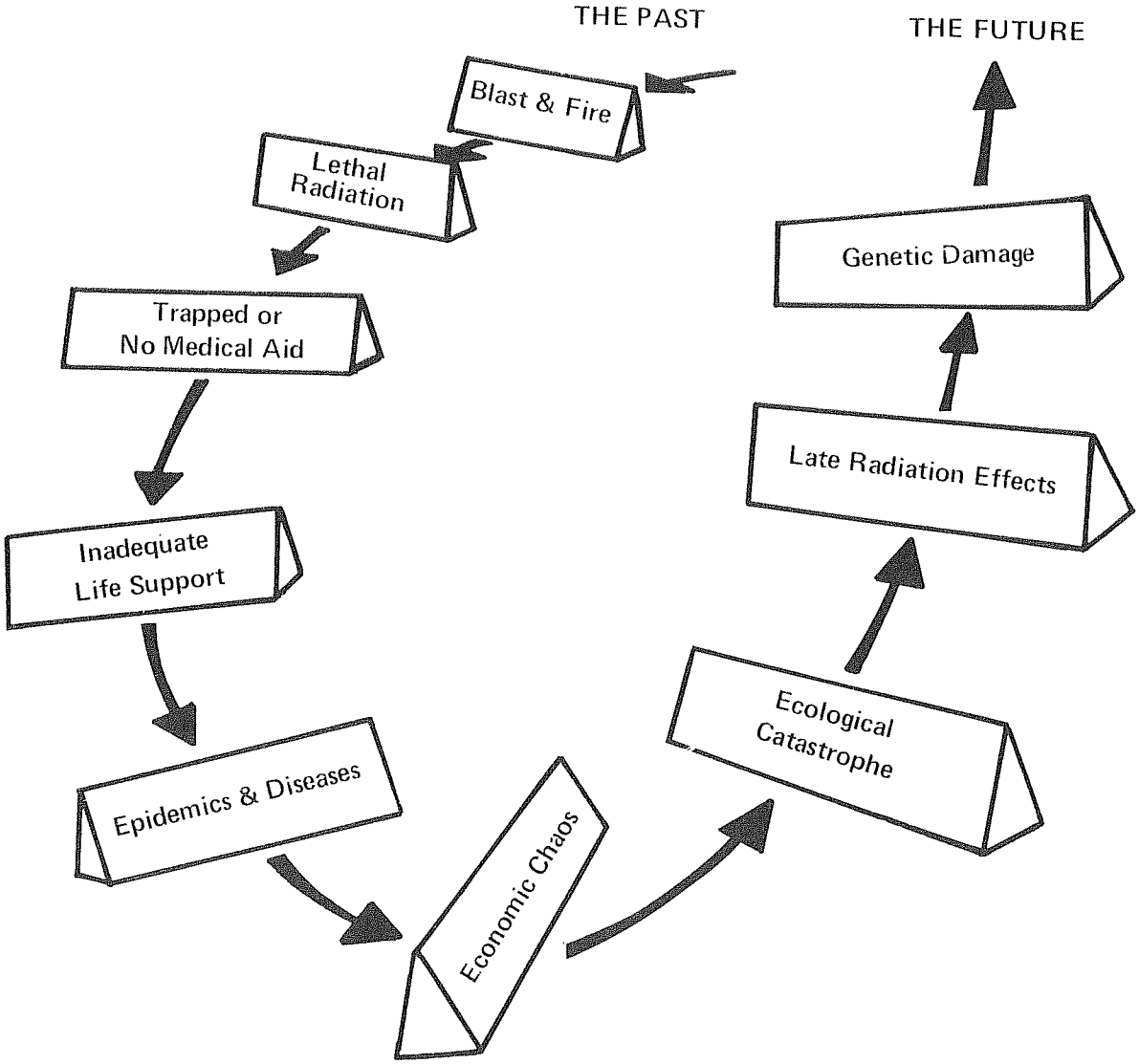
This rhetorical question headed one of the chapters in Herman Kahn's 1960 book, **On Thermonuclear War**, a book that was an outgrowth of a Rand Corporation civil defense study of the late 1950s. Kahn's answer, based on the Rand study, was that though the amount of human tragedy would be increased in the postwar world, the increase would not preclude normal and happy lives for the majority of survivors and their descendants. Said Mr. Kahn, "My colleagues and I came to this conclusion reluctantly; not because we did not **want to** believe it, but because it is so **hard** to believe. Thermonuclear bombs are so destructive, and destructive in so many ways, that it is difficult to imagine that there would be anything left after their large-scale use."

In Chapter 1 of this Manual, we saw that most of the U.S. population could survive the immediate effects of an attack such as the Soviet Union can now deliver, **especially if the defensive knowledge we have is fully applied in civil preparedness planning.** But this is only part of the problem. Will the post-shelter environment be so hostile that we or our descendents might prefer not being alive? To what measure can we restore the prewar conditions of life? Will more people die of disease and starvation than were lost in the attack itself?

As suggested by this allegorical sketch, the Nation's people, individually and as a society, have a series of hurdles or barriers barring their way that must be surmounted if they and their descendents are indeed to enjoy normal and happy lives. Most civil defense planning has focused on the first three of these barriers: all-effects shelter or crisis relocation to cope with the direct effects barrier, fallout shelter and radiation detection instruments to cope with potentially lethal fallout radiation, and rescue and medical care preparations to succor the trapped and injured. This is as it should be. Failure to surmount the initial barriers would make the remaining problems academic. But, in a very real sense, all **nine** of these barriers must be surmounted. If there is catastrophic failure at any hurdle, there will have been little value in success at the others. When some people conclude that nuclear attack means total annihilation or that post-shelter life won't be worth living, they usually have singled out one or more of the later barriers as insurmountable.

In this Chapter, we will discuss what is known about these barriers to well-being, particularly the last six, and what the planner can reasonably plan to do about them.

NINE BARRIERS TO WELL-BEING*



*Based on Greene, J.C., **The Case for Civil Defense**, DCPA Research Report No. 16, 1972 (AD 758 452).

POSTATTACK RECOVERY

Another useful viewpoint for coping with the post-shelter environment is shown here. It is the view that might occupy the attention of the Nation's leaders or that might be described in a history of the aftermath of a nuclear war.

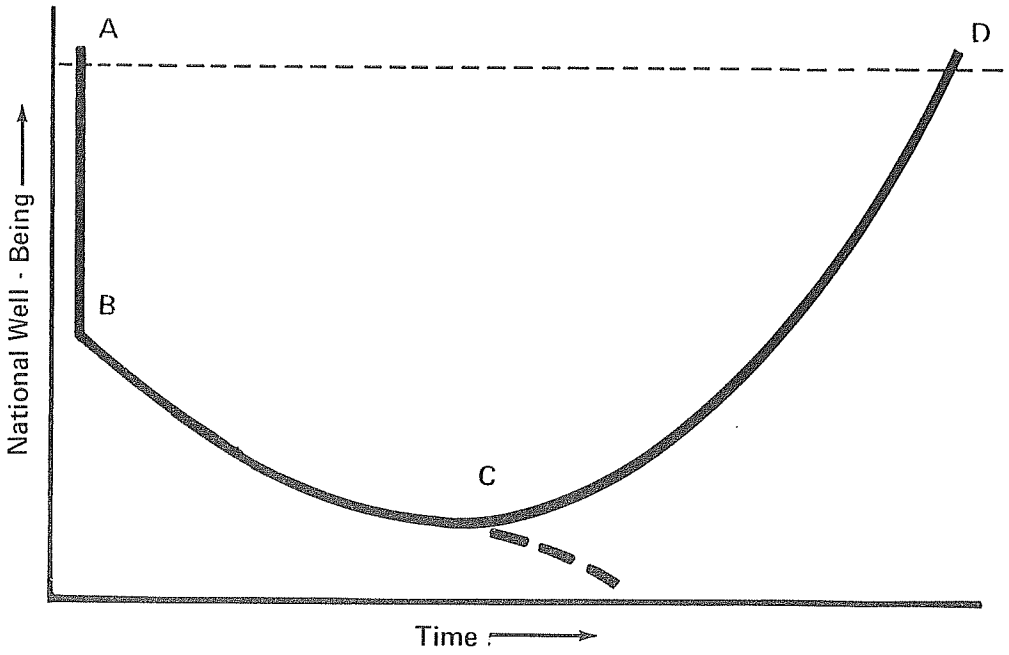
National well-being may be considered as a composite of population, material resources, and social and economic institutions—the basic elements that make for a viable country. Prior to the attack, the national well-being is high, as shown at Point A. The immediate consequence of the attack is a sharp drop in well-being (Point B), with millions of dead and injured, great destruction of resources, and disorganization of institutions, such as government, banking, private ownership, and the like.

It is reasonable to expect that the initial sharp drop would be followed by a further decline in well-being because of continuing fallout radiation exposure, deterioration of abandoned factory machinery, wastage of scarce resources, inadequate mutual aid, lack of communications, and general disruption of normal patterns of living. Initial coping efforts would attempt to "stabilize" the situation and satisfy the most pressing wants so that sooner or later a minimum or "bottoming out" should occur (Point C), after which the Nation would begin its upward path to recovery (Point D).

There is a possible alternative history that the national leadership will strive to avoid. It is indicated by the downward dashed line at Point C, which implies that deterioration is so severe or management so inept or misdirected that national recovery does not occur at all, and the country degenerates into chaos and anarchy.

This viewpoint focuses on the need for national goals, goals widely shared at all levels of government and among the public at large. No local government nor wider region can recover by itself. The emergency planner must recognize in his planning that, while localities can (and may need to) deal with the first three barriers without outside help, adequate life support (food, water, and protection from the elements) may require inputs from outside the jurisdiction. Surviving organizations must consciously "coalesce" into wider and wider communities of common action if disease epidemics are to be controlled and economic chaos avoided.

A POSSIBLE CHAPTER IN AMERICAN HISTORY



PANEL 2

SOCIAL AND PSYCHOLOGICAL NEEDS

As will be seen in this Chapter, there is little question that the surviving physical and human resources following an attack that could be delivered at this time are sufficient to permit a meaningful recovery. A good deal, however, will depend on the will and cooperation of the survivors.

The people, who are the most valued part of the National entity, are at the same time the source of one of the critical post-shelter resources: **manpower.** Therefore, the social and psychological effects of undergoing a massive attack by nuclear weapons could play a decisive role in determining whether the survivors would have the will and capacity to accomplish what appears to be possible. Recently, a panel of behavioral scientists, government officials, and military staff officers, who had experience in studying or planning for the nuclear attack contingency, developed a consensus on the social and psychological factors they felt would significantly influence the behavior of people after a heavy attack on this country. It is significant that the panel, virtually unanimously, put at the top of the list the early satisfaction of the psychological needs shown here. The near unanimity of the panel on these priorities focuses the attention on the need for **communications between the government and its constituents.**

As noted in Chapter 7, the process of providing leadership, information, reassurance, and instruction should be initiated in the shelter environment. This would be aided greatly by trained shelter managers and communications with the local EOC. Reliable one-way communication from various levels of government to the people is essential. There are over 8000 privately-owned AM, FM, and TV broadcast stations in the United States. Several thousand of these participate in the Emergency Broadcast System (EBS), designed to provide the President, the Federal Government, and State and local authorities a means of communicating with the general public during the preattack, transattack, and postattack periods. However, only about 600 broadcast stations have been provided with emergency electric power and a fallout-protected broadcast studio. Many have facilities for remote programming from the local or State EOC. In view of the potentially damaging effects of the electromagnetic pulse on operating transmitters (see Chapter 4), it would be good planning to arrange with even non-participating broadcast stations to take EMP protective measures when they go off the air in an emergency. These stations could provide an important resource for communicating information, reassurance, and instructions in the post-shelter environment.

PANEL 3

PRIORITY NEEDS*

1. People would need leadership.
2. People would need information.
3. People would need reassurance.
4. People would need instructions.

*From Allnutt, Bruce C., **A Study of Consensus on Psychological Factors Related to Recovery from Nuclear Attack**, Human Sciences Research, Inc., May 1971. (AD 730 360)

WHAT THE WAR WAS LIKE

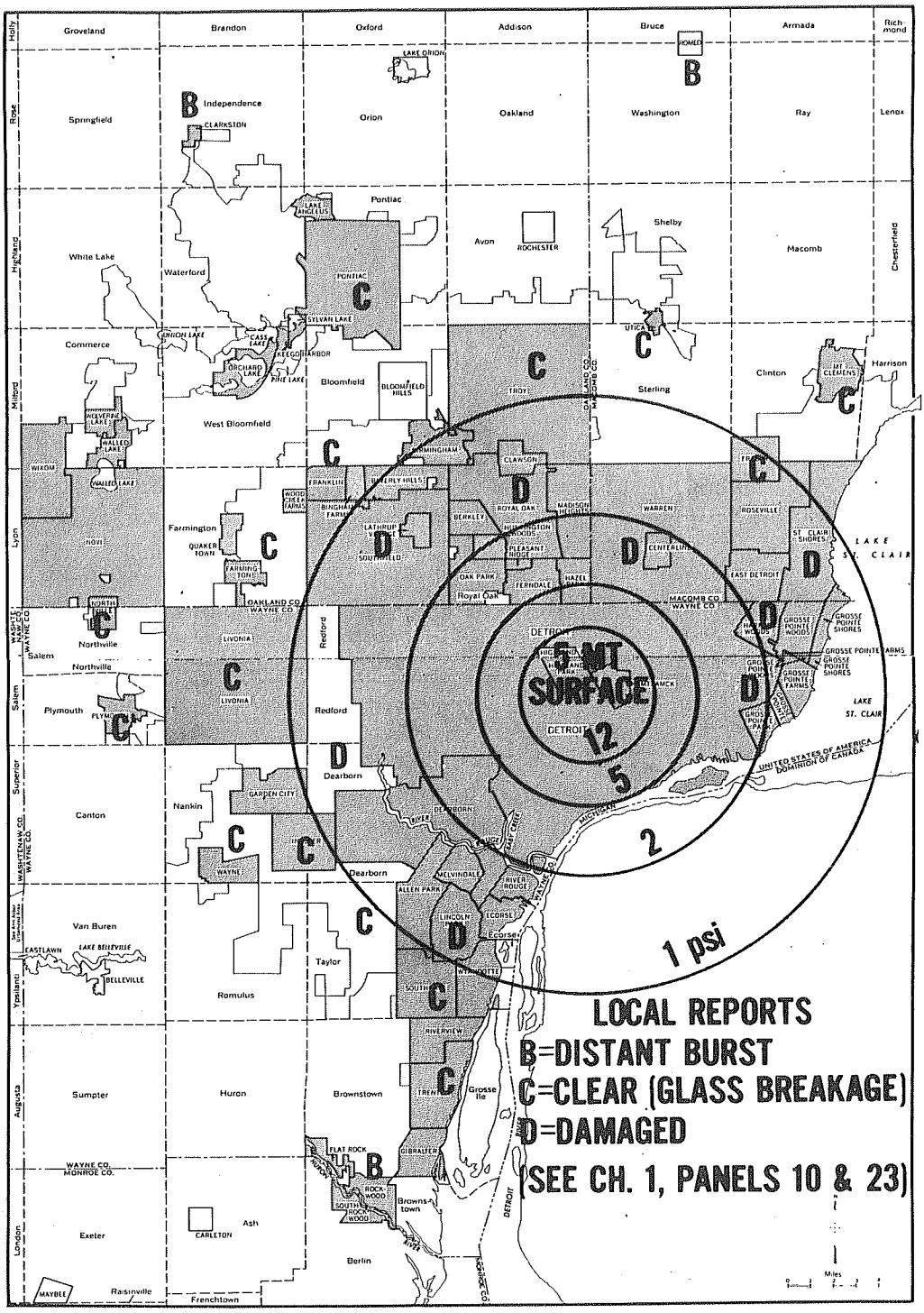
One of the problems of planning for a potential nuclear conflict is that the attack could take on a variety of forms. We do not know in advance whether cities will be struck, which military bases will be attacked, or whether detonations will be fallout-producing surface bursts or air bursts. We do not know whether EMP damage will be widespread, whether fires will get out of hand, or how well radiation injuries will be avoided. It is because of these basic uncertainties that nuclear emergency planning must be **contingency planning** that takes into account all reasonable possibilities.

The post-shelter environment has a significant feature: we will **know** what the war was like. Or, more accurately, what has occurred is knowable. We can learn which cities have been spared and which are in ruins, where the fallout is and where it is not, and how many have survived and their condition. Fallout radiation will be measured and the effects of radiation on people will be observed, thereby replacing the peacetime research findings given in Chapters 5 and 6. Damage to buildings, utilities, supplies, and industrial machines will be observable and may or may not conform to the estimates of Chapters 2 and 3. In other words, **damage assessment** will be a necessary first step to provide the essential information upon which local, State, and national post-shelter operations can be based.

The earliest and simplest attack effects information will be reported during the in-shelter period in the form of Basic Operating Situation (BOS) information (see Panels 20 and 23 of Chapter 1) or equivalent reports of "glass breakage," "structural damage," and color-coded fallout situation reports. Using these reports, damage assessors at State and Federal Regional EOCs can "fit" direct effects templates to include localities that report damage and exclude those that report only glass breakage, as shown here. Once an approximation of the locations and sizes of damaged areas is available, these can be laid over "lattices" of population, housing, and similar pre-attack data to get a first estimate of "what probably happened." At the national level, damage estimation would be done by computer because of the size of the task.

The urgent need to know "what happened," so that aid and recovery efforts can be planned, focuses the attention on the need for **communications between various levels of government** and **between mobile units (and the people) and the local authorities in the EOC.** Since communications are almost certainly to be disrupted by the attack, early restoration of communications is a priority task to be planned for in the post-shelter environment.

DETROIT URBANIZED AREA



PANEL 4

THE FALLOUT CONSTRAINT

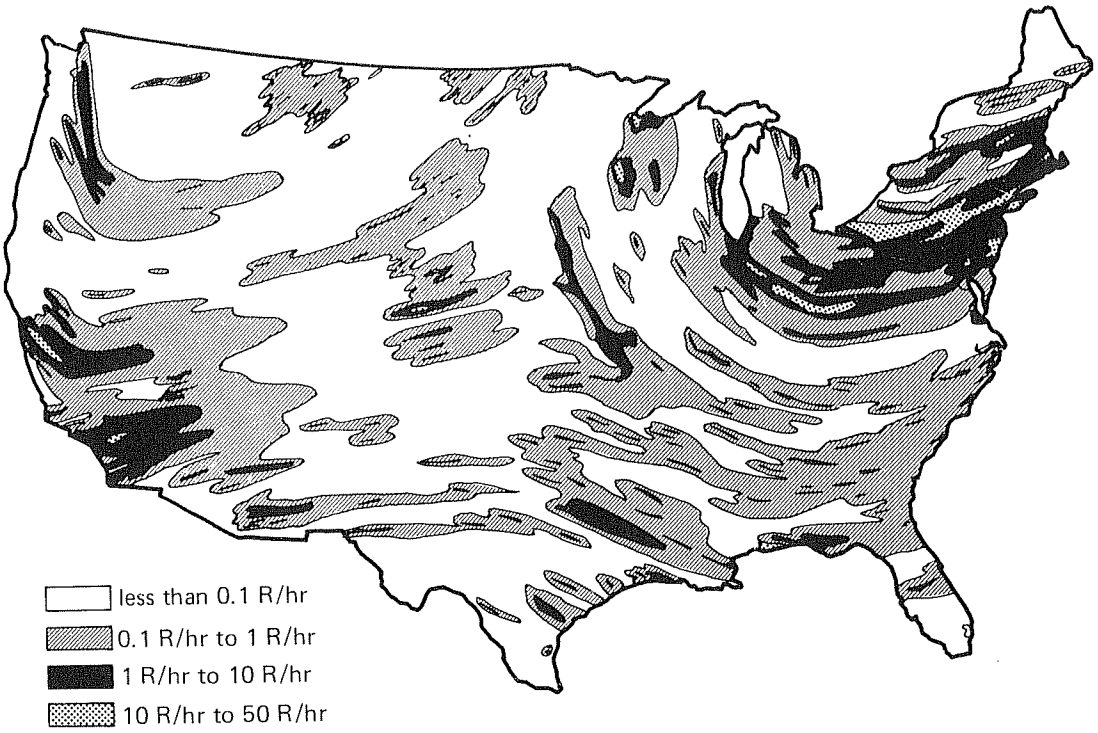
Gamma radiation from fallout is the attack effect that may persist in the post-shelter environment in amounts sufficient to cause injury or death. Studies of possible attacks in which fallout-producing surface bursts are assumed to occur indicate that, by one week after the last detonation, no part of the U.S. would be in a HIRAD situation (dose rate in excess of 50 R/hr).

The example fallout map shown here indicates the areas of the United States in which dose rates at the end of the first week could restrict post-shelter operations, as estimated by the Miller fallout model for the winds of a particular Spring day. An attack is assumed in which a portion of the weapons, amounting to about 2500 megatons, is detonated on the surface to cause fallout. In the clear areas, the dose rates at the end of the first week are estimated to be less than 0.1 R/hr (100 mR/hr). The dose rates in the lined area would range from 0.1 R/hr to 1R/hr. The black areas would have dose rates between 1R/hr and 10 R/hr. There are several stippled areas on the map where the one-week dose rates would be over 10 R/hr.

Time would further reduce the fallout radiation hazard. Using the 7-10 Rule discussed in Chapter 6, seven weeks after the attack the lined areas would become clear, the black areas would become lined areas, and the stippled areas would be black areas. To achieve a further factor-of-10 reduction would require, according to the rule, another seven-fold passage of time (49 weeks, or nearly one year after attack). Actually, increasingly rapid decay after six months and the effects of weathering would leave few, if any, areas outside the bomb craters above 100 mR/hr at year's end.

If the people are instructed and guided to limit exposures so as to avoid post-shelter radiation sickness, the principal effect of fallout radiation during the early months would be to delay the accomplishment of recovery activities. Delay would occur for several reasons. Recovery workers would need to restrict their exposure outside shelter to a shorter workweek in most cases. Survivors most able to participate in the recovery work force would be those in the best fallout shelters or those coming from areas experiencing little fallout, thereby limiting the size of the work force. Survivors manifesting symptoms of radiation sickness during the first week would have to remain in shelter or be transported to less-contaminated areas. It can be seen from the map that the distances to be traveled from heavy fallout areas to areas of much lower hazard are not great in most instances.

EXAMPLE FALLOUT MAP
(DOSE RATES AT ONE WEEK)



PANEL 5

DECONTAMINATION

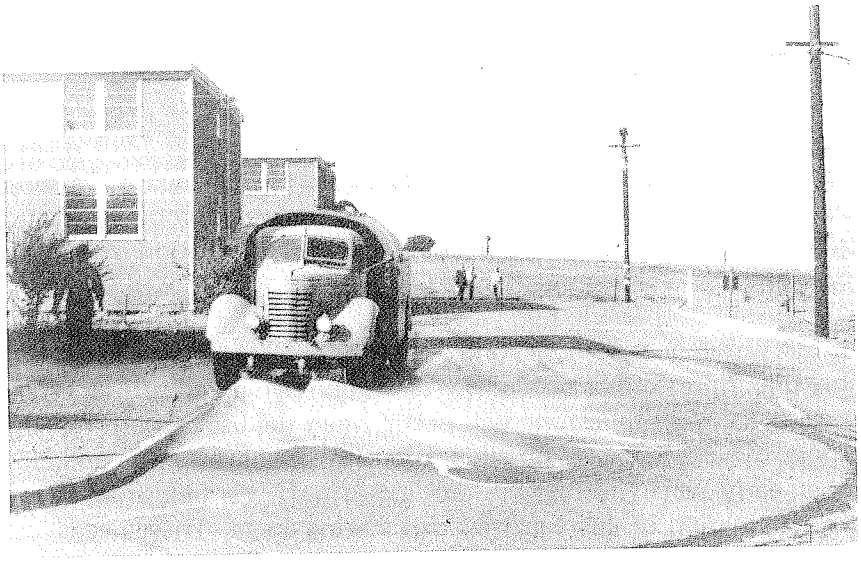
As noted in Chapter 6, the delays caused by fallout radiation can be reduced greatly by decontamination, a process in which the deposited fallout is removed from surfaces and placed where it can no longer irradiate people. Thus, if 90 percent of the fallout material affecting a workplace could be removed in the first few weeks, a situation would be created that would not occur otherwise until many months later. Halving the dose rate would permit recovery workers to work twice as long as would otherwise be the case.

Outside damaged areas, decontamination can be accomplished using a variety of common methods. Flushing fallout particles from roofs and paved surfaces and into the storm drains by means of a firehose has been found to remove over 90 percent of the fallout material. An hour's work by three men with a firehose will clean 1800 square feet of roof or 15,000 square feet of paved area. Motorized street flushers and street sweepers are more effective on paved areas and three to five times faster. Open ground areas can be scraped by earth-moving equipment: scrapers, graders, or bulldozers. These methods typically remove a slice of native soil amounting to several hundred times as much as the thin coating of fallout removed with it. The scrapings must be dumped at a remote corner of the cleared area. With room to maneuver, these methods are as effective as the paved area methods and almost as fast.

In damaged areas, widespread debris will complicate the decontamination process. If water pressure has been restored, the preferred decontamination procedure is to fire-hose an area 30 to 50 feet in radius around the debris-clearing equipment, flushing the exposed fallout down into or under the debris piles. Then, the street or area can be cleared of debris, and the remaining fallout in the cleared area can be flushed into the drains. Without water, debris removal must occur first, followed by motorized sweeping or vacuuming of the fallout.

Because of the specialized equipment and operator skills required by most decontamination techniques, widespread decontamination of whole cities does not appear practical during the first month or so. Decontamination will be useful to permit key utility plants, staging areas, and supply warehouses to be operated safely in the first weeks after attack. Later, a large part of the population can be usefully employed in mass clean-up efforts, using household brooms, garden hoses, and shovels. Calculations have shown that such efforts can result in significant reductions in population exposure to radiation over the long term.

SOME DECONTAINATION OPERATIONS*



Decontaininating with a street flusher

Removing fallout from an unpaved area.

*From Owen, W.L., and Sartor, J.D., **Radiological Recovery of Land Target Components - Complex III**, U.S. Naval Radiological Defense Laboratory, November 1963 (AD 433 141).

RESTORING THE WATER SUPPLY

The first post-shelter hurdle that must be overcome is inadequate life support for the surviving population. The essential life-support needs are water, food, protection from the elements (housing and clothing), and health care. Of these, restoration of an adequate water supply is the most urgent.

The need for water goes well beyond the provision of potable water for drinking. Water, preferably under pressure, is needed for sanitation, which, in turn, is essential to public health. An early recovery milestone will occur when the use of flush toilets is regained, baths and personal hygiene become possible, utensils can be cleaned, and clothes can be washed. Another early water need is for fighting of fires. In fallout areas, water will be needed for decontamination of key facilities and staging areas. These needs justify making restoration of waterworks operations the first recovery goal.

In undamaged areas, restoration of the water supply may depend only on the availability of electric power to operate pumps and chlorinators. See Chapter 4 for the reasons why widespread loss of electric power is likely as the result of an attack. Since electric utilities normally serve broad geographical areas, plans should be made to obtain from the State an estimate of the time that power is likely to be restored in undamaged areas. If restoration of electrical service is not likely during the second week after attack, portable emergency generators in the vicinity should be moved to the waterworks on a priority basis. Plans should define the power needs of each water facility and where auxiliary sources of generators and fuel are to be obtained. If portable generators are unavailable, induction motors can be converted into generators as described in Panel 14. Other actions may be needed to restore the water supply, such as decontamination of the works to minimize radiation exposure of essential operators. Supplies for water treatment facilities may need to be replenished.

Water quality control in the immediate post-shelter period may not be of crucial importance in undamaged areas since boiling and other measures can be instituted to improve potability. Much of the population is served by water systems that use ground water from wells that should be free of fallout contamination. Even where this is not the case, there are usually a number of commercial concerns, such as breweries, that have their own water supplies independent of the municipal supply. Also, older maps of an area may show locations of wells and springs no longer used that might be potential sources of supply.

The emergency planner needs to know where these sources are so that safe drinking water can be provided, especially for the children, during the first month (see Chapter 6). In damaged areas or where water sources are polluted, water may be hauled in and distributed by tank truck until undamaged portions of the utility distribution system can be put back in use through rerouting, isolation of damaged piping, and repair of the works itself.

WATER IS URGENTLY NEEDED FOR:

- Drinking
- Flushing Toilets
- Bathing and Washing
- Cleaning and Scrubbing
- Laundering
- Firefighting
- Decontaminating
- Industrial Processes

ESTABLISHING THE FOOD SUPPLY

As noted in Chapter 6, fallout radiation may injure or kill many growing crops and food animals and may prevent farm workers from caring for them for a period of time. No essential agriculture need be delayed beyond the following year's growing season. Whether surviving food stocks would be sufficient to carry the population through the harvest of the next year's crops has been the subject of several studies, results from one of which are shown here.

These statistics could lead to considerable optimism unless it is noted at once that only the last two items constitute the immediately available food supplies, processed for human consumption. About 70 days of supply is available. Some of this supply may be lost in the attack, of course, but, on the other hand, the supply has been measured in terms of the pre-attack population.

Since crops in the field and farm animals are vulnerable to attack effects, the biggest potential source of supply is grain stocks. These stocks fluctuate from season to season and from year to year, depending on world market conditions. The bulk of these stocks is not located near the population centers and requires some processing before reaching the consumer. Emergency transportation of food will be a critical post-attack problem. Estimates indicate that surviving rail and truck transport will be adequate for priority food shipments. Food processing plants may be located where damage is likely. Other grinding facilities may need to be adapted to the milling of grain. Grain normally grown for animal feed may have to be diverted to human use. The U.S. Department of Agriculture is responsible for post-attack management of "primary" food resources and for the complex processing and distribution of them. State and local governments must control the use of "secondary resources" of food in the hands of local wholesalers, retailers, in households. As discussed more fully in Panel 19, current plans involve consumer rationing of essential items, including food, even in undamaged localities where supplies would appear to be ample.

In effect, the local government takes charge, using private food organizations and personnel as feasible. So long as much of the population is retained in public shelters (whether the attack environment demands this or not), delivery of food based on shelter head-count is an automatic form of rationing. Individual families surviving in residential basements will be dependent on household stocks during this period. As shelter emergence becomes desirable, food distribution may continue as a mass feeding program based on the shelters, work places, elementary schools, and staging areas. Only when housing is re-established and necessary utilities and fuels are judged to be in adequate supply is over-the-counter rationing and home preparation of meals likely to be feasible.

NATIONAL FOOD SUPPLY*

	Days Supply**
Farm Crops in the Field (Grains only on July 1st)	1163
Grain Stocks	
Food Processors and Private Storage	457
Government (CCC) Inventory	103
Farm Animals (Cattle, Hogs, Poultry)	105
Food Processors and Interstate Warehouses	45
Local "Secondary" Resources of Food (Wholesalers, Retailers, and Households)	25
Grand Total	1898***

*Based on 1969 data in A.F. Shinn, **Vulnerability of the U.S. Food Supply and Food Distribution to Nuclear Attack**, Oak Ridge National Laboratory, 1969.

**Assumes 3000 calories daily for 203 million people.

***Neglecting crops in the field and farm animals leaves 630 days of supply or nearly two years of food, mostly grain.

EMERGENCY HOUSING

To the extent that people have survived the attack environment, both direct effects and fallout, the areas where they were sheltered may continue to offer adequate protection against the elements. We saw in Chapter 2 that people can survive blast and fire effects better than houses. Thus, millions of homeless survivors can be expected after a nuclear attack. Some portion of these will have been driven from untenable shelters during the emergency period and will have had to seek shelter elsewhere. Nonetheless, providing of emergency housing is unlikely to be as urgent in the post-shelter environment as would be assuring the survivors that water will be available for drinking and personal hygiene and that no family or small group need forage on their own for the next meal.

Post-shelter emergency housing will be important to plan for not only for health reasons but also for morale purposes. Just as the opportunity to take a bath is likely to mark an early postattack milestone, so will the opportunity to sleep once more in a bed in the privacy of one or more rooms assigned to a family. As shown in this chart, such relative comfort is likely through use of only surviving housing units because Americans presently enjoy housing accommodations that are quite roomy compared to those in many other countries of the world.

A measure of adequacy in emergency housing would likely be the criterion of 40 square feet per person used following peacetime disasters. This is four times the DCPA shelter space allotment but far short of the space normally available in U.S. housing units, the majority of which have five or more rooms. In areas nearby nuclear detonations, a major repair task will be to cover in various ways the window openings that have been blown out by the blast wave. In fallout areas, occupancy of emergency housing during the first month may require converting multi-story office buildings into dormitories by bringing beds from the less protective residences or decontamination and intensive use of selected multi-unit dwellings until the rest of the housing can be safely used. In any event, occupancy of emergency housing will entail the restoration of electric power, water, and the availability of fuel for heating and cooking.

Ultimately, the housing destroyed in the attack will have to be replaced to the extent the survivors require it. A standard of housing approaching the preattack situation is consistent with recovery goals and with the need to assure the public of the return of private property to its rightful owners at the earliest possible time and the replacement of losses through some system of loss sharing. This is a longer-term matter that will be planned for at the Federal level in conjunction with recovery of industrial production.

PANEL 9

HOUSING SPACE IN VARIOUS COUNTRIES*

Place	Persons per Room	Relative to U. S.
United States	0.6	1.0
Canada, United Kingdom	0.7	1.2
France, West Germany	0.9	1.5
Puerto Rico, Italy	1.1	1.8
Czechoslovakia, Finland	1.3	2.2
Soviet Union, Greece	1.5	2.5
Poland, Yugoslavia, China	1.7	2.8
India, Guatemala	2.6	4.3

* From United Nations Statistical Yearbook, 1971.

PUBLIC HEALTH

Survivors of nuclear attack may be exposed to endemic diseases capable of rapid development to epidemic proportions in an uncontrolled post-shelter environment. There are some 14 diseases of man that may increase sharply unless early priority is given to adequate sanitation and public health measures. The need for disposal of human wastes and personal cleanliness was referred to in Panel 7 as an important reason for early restoration of water service. This implies that provision of electric power for sewage treatment plants and sanitary lift stations must be given equal priority. Where damage has occurred, repairs to the sanitary waste-disposal system must be scheduled concurrently with repairs to the water system, if people are to be housed or sheltered in the area.

In addition to human waste disposal, major public health problems will be created, especially in damaged areas, by the creation of breeding areas for flies, rodents, mosquitoes, and other disease-carrying species. In all but the winter season, intestinal (enteric) diseases, such as Shigellosis, Salmonellosis, and infectious Hepatitis, could erupt to epidemic proportions because of greatly-increased numbers of flies. A large increase in the fly population can be expected if organic wastes are left uncollected for more than a week.

Garbage and rubbish produced incidental to feeding the population will constitute a relatively small part of the putrefying organic matter. In blast areas, the bodies of the deceased must be collected and buried. Animal corpses must also be disposed of. Solid organic wastes are likely in damaged industrial plants, warehouses, food and produce markets and in households. If electric power has been out for more than a week or so, frozen and refrigerated products will have begun to deteriorate. Food that is beyond reclaiming must be treated as organic waste.

Studies have shown that a supply of insecticides and poisons can be expected to remain available for vector control following attack. The most important single operation is that of collecting and disposing of solid organic wastes. Next in priority is the control of houseflies, along with mosquito control. The table suggests a post-shelter schedule of activities to be undertaken.

POST-SHELTER SANITATION NEEDS*

DESIRED SCHEDULE	ORGANIC WASTE COLLECTION	FLY CONTROL	RODENT CONTROL	MOSQUITO CONTROL
First Week	Undertake at High Priority	Begin Adulticide	Wait	Wait
Second thru Fourth Week	Continue as Necessary	Continue as Necessary	Place Poisons & Traps	Begin Larvacide
Second thru Twelfth Month	Return to Normal Collection	Return to Normal	Return to Normal	Return to Normal

*Based on **Postattack Sanitation, Waste Disposal, Pest and Vector Control,** Engineering-Science, Inc., January 1967 (AD 645 599).

TREATMENT OF INJURED SURVIVORS

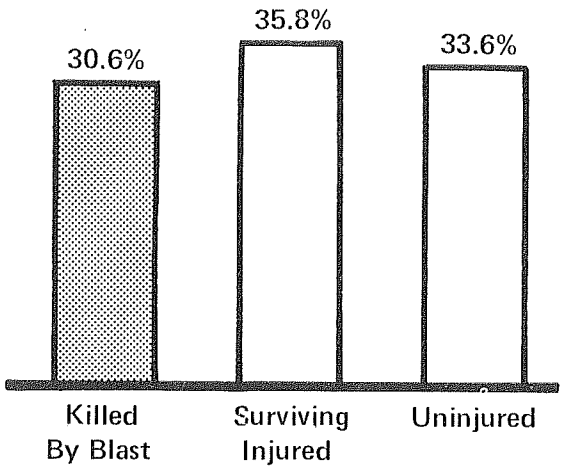
It is sometimes useful to consider post-shelter medical care needs in two time periods: (1) an "immediate postattack period," lasting the first month, in which the treatment of injured survivors is the most important medical problem; and (2) a "late postattack period," covering the remainder of the first year, in which treatment of victims of communicable diseases is the central health care need.

In the immediate postattack period, treatment of trauma (wounds and broken bones) and burns creates the greatest demand for professional care by physicians and surgeons. There is no specific treatment for radiation sickness beyond bed care, cleanliness, and replacement of fluids. This can be provided by relatively untrained personnel. Proper treatment of injuries and burns, however, places a heavy demand on those who possess specialized medical skills. A characteristic of nuclear attack is that the numbers of surviving injured are expected to equal or exceed those killed by blast. This could mean tens of millions of injured survivors throughout the nation. Since today there are only about 1.5 physicians and 10 auxiliary medical personnel (dentists, veterinarians, nurses, etc.) per 1000 population, case loads would be many times normal even if emergency plans placed medical personnel in the most survivable shelter locations.

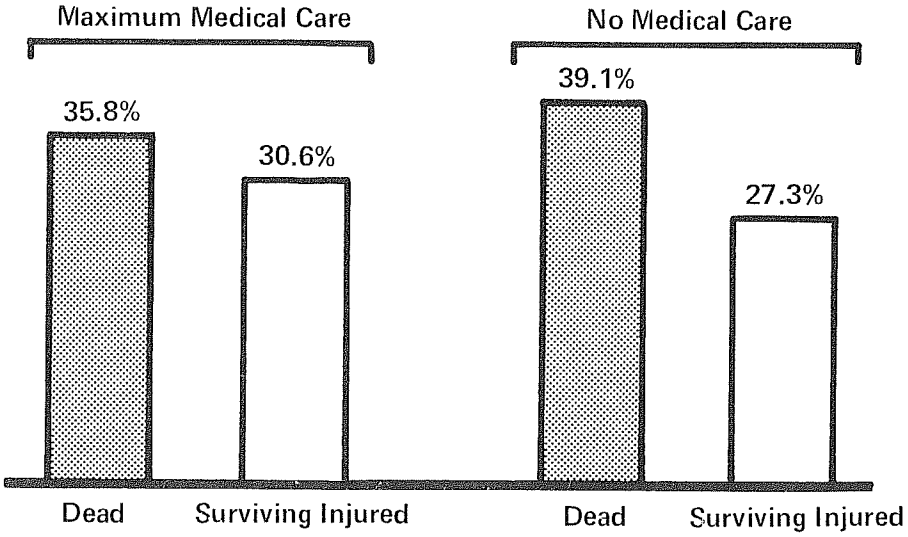
Studies, such as the one illustrated here, have indicated that medical care would have only a limited effect on the number of fatalities because most of the injured either would be beyond help when they could be treated or would survive in any event. The example shown is a detailed case study of casualties following an assumed attack on the Detroit metropolitan area. The upper bar chart shows an estimate of the situation 24 hours after the attack. The lower bar chart shows the estimate for 30 days after attack, assuming on the one hand peacetime levels of medical treatment and no treatment on the other. The estimates were formed by defining injury types in detail and then consulting hospital and medical records to predict outcomes. The complicating effect of fallout radiation injury was also taken into account.

The results show about three-quarters of the surviving injured would have survived without medical care. About 15 percent of the surviving injured would succumb during the 30-day period despite maximum medical care. Approximately 10 percent of the surviving injured could be saved by such medical treatment. In the study cited here, the medical care judged to have been available after the assumed attack did not save any significant number of the surviving injured. Later analyses have indicated that post-shelter medical treatment might have an important effect on the "quality of survival" and how rapidly the injured can be returned to a useful place in society.

EFFECT OF MEDICAL TREATMENT*



ESTIMATE AT ONE DAY



ESTIMATE AT THIRTY DAYS

*Based on Pyecha, J.N., et al., **Alternative Designs for Systems for Providing Postattack Medical Care**, Research Triangle Institute, October 1970 (AD 718 081).

TREATMENT OF DISEASE

Degradation of the public health measures discussed in Panel 10, difficulties in maintaining personal cleanliness, poor nutrition, and radiation injury could lead to post-shelter increases in communicable diseases, possibly of epidemic proportions. In contrast to attack injuries, where the availability of doctors is the limiting factor in effective treatment, the critical element in treatment of communicable diseases appears to be the adequacy of medical supplies, particularly drugs and medicines. Like attack injuries, communicable diseases can affect a large fraction of survivors. But, unlike attack injuries, effective medical treatment can be achieved and will have a great impact on preventing further loss of life in the first postwar year.

In addition to the public health measures already discussed (water and sewage control, organic waste disposal, and insect and rodent control), one set of post-shelter medical and public health priorities is shown here. Isolation of infectives when diagnosed is of greatest importance. In addition, maintenance of the "external quarantine" to prevent entry of diseases such as yellow fever and typhus into the country is needed, since the population is defenseless against many diseases that no longer are endemic in this country. Some diseases, such as plague and tularemia, are transmitted from wild rodent reservoirs. The general rural relocation of survivors that may occur either preattack or postattack could increase contact with the animal reservoir. Close surveillance of these threats may be necessary.

Physicians are normally dependent on laboratory tests to aid in diagnosis of disease so that the proper treatment can be instituted. Many, if not most, of these medical laboratories may be unusable by attack effects. An early post-shelter need will be to establish surviving laboratories to service the medical diagnostic needs of a much larger area than was common prior to attack. Lacking adequate diagnostic tools, broad-spectrum antibiotics to treat an uncertain range of possible diseases will be in great demand. Early production of these preparations in quantity will be necessary.

After the first few months, measures will need to be taken to provide as well-balanced a diet as possible, with attention to sources of protein and vitamins, without which people will become more susceptible to infection and suffer more severely from illness.

PRIORITIES FOR COMMUNICABLE DISEASE CONTROL*

1. Isolation and Quarantine.
2. Disease Surveillance.
3. Establishing Regional Diagnostic Laboratories.
4. Drug Production, especially Antibiotics and Disinfectants.
5. Production of Immunologicals.
6. Food Quality Control.

*Based on H.H. Mitchell, M.D., **Guidelines for the Control of Communicable Diseases in the Postattack Environment**, R&D Associates, July 1972 (AD 748 343).

RESTORING ENERGY SUPPLIES

Virtually all activities in the immediate post-shelter period needed to provide life support and health care to the surviving population will require sources of energy: electric power, gas, petroleum fuels, and the like. Of these, electric power is the energy source of widest immediate use. Electric power will be needed for the all-important communications among organized civil defense forces and between the government and the people. Except for limited use of gravity systems, water service cannot be restored nor can sewage disposal become effective without an electric water supply.

Recovery activities would largely be limited to daylight hours unless building and street lighting is available. Treatment of injured survivors also will be difficult unless electric power is available. One special problem of immediate significance in the postattack period is the fate of food, mainly meat, in cold storage and freezers at wholesale, retail, and household levels. These supplies of protein will be of great nutritional value to the survivors. Moreover, unless power for refrigeration is available within about a week of power loss, these potentially valuable supplies will become organic wastes constituting a health hazard until collected and disposed of.

Electric power will be needed to operate fuel pumps so that public safety vehicles, repair vehicles, and essential transport can continue to operate. Many of the tools and equipment used in the repair of communications, water, sewage, and other key facilities also require electric power. Finally, electric power will be needed in undamaged industrial plants where essential survival items such as pharmaceuticals must be produced.

Restoration of electric power in damaged areas is likely to be a slow process. Power outages in undamaged or lightly-damaged areas may not take many days to correct since many power generating stations are located where they are likely to survive and the power systems are well interconnected. Inventories of coal and other fuels needed for power generation may, however, be in short supply. Many key facilities, such as emergency control centers, radio transmitters, and hospitals already have installed emergency generators to substitute temporarily for electric power service. Thousands of portable generator sets also exist that could be brought to key facilities not so equipped. Should sources of emergency power be unavailable or insufficient, there are **expedient** ways to produce electric power. These are discussed in the following panel.

ELECTRIC POWER IS NEEDED URGENTLY FOR:

- COMMUNICATIONS
- WATER SUPPLY
- WASTE DISPOSAL
- LIGHT
- MEDICAL TREATMENT
- FOOD PRESERVATION
- FUEL PUMPS AND REPAIR TOOLS
- ESSENTIAL SURVIVAL ITEM PRODUCTION

EXPEDIENT ELECTRIC POWER

Standby power plants installed in communication centers, hospitals, and some other key locations serve important but limited purposes. Portable engine-generator sets are rather widely available but the total capacity they represent is small compared to the potential demands for electric power in the immediate post-shelter period. What most emergency planners do not know is that most electric motors (the induction motors) can be converted into electric generators to provide power to drive other motors, the pumps in waterworks and sanitary lift stations, for example. The number of unessential motors suitable for conversion is enormous and could, theoretically, provide virtually all the emergency power needs of the nation.

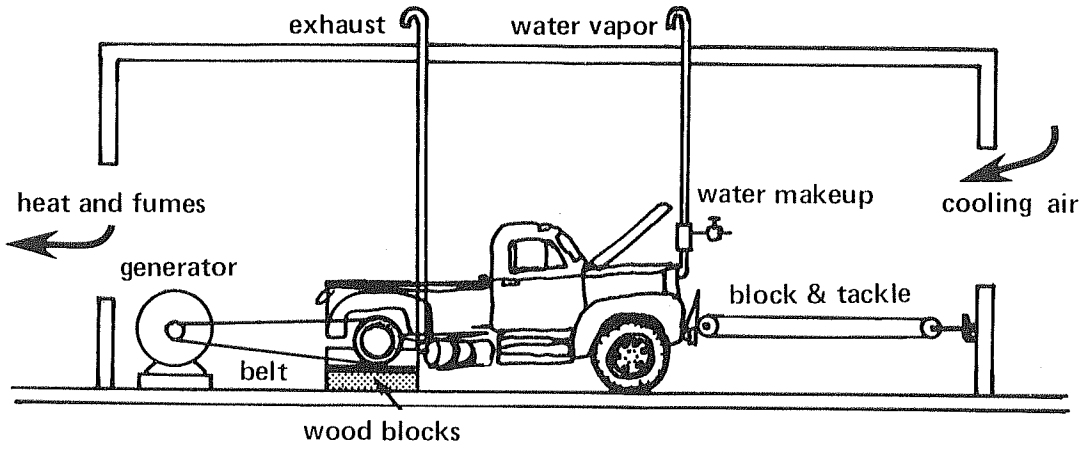
An induction generator is an induction motor that is driven by an engine (the prime mover) so that, instead of working as a motor, it becomes a generator of electric power, as shown in the upper sketch. Some electrical components are also needed but they are usually to be found in factories or office buildings. The information presented in the lower sketch is intended only to convey a general idea of what an expedient induction generator setup might be like. **How-to-do-it information** that can be understood by electricians or power engineers can be found in the reference cited below the sketches, **which should be consulted, especially for safety advice.**

The major components of an induction generator are:

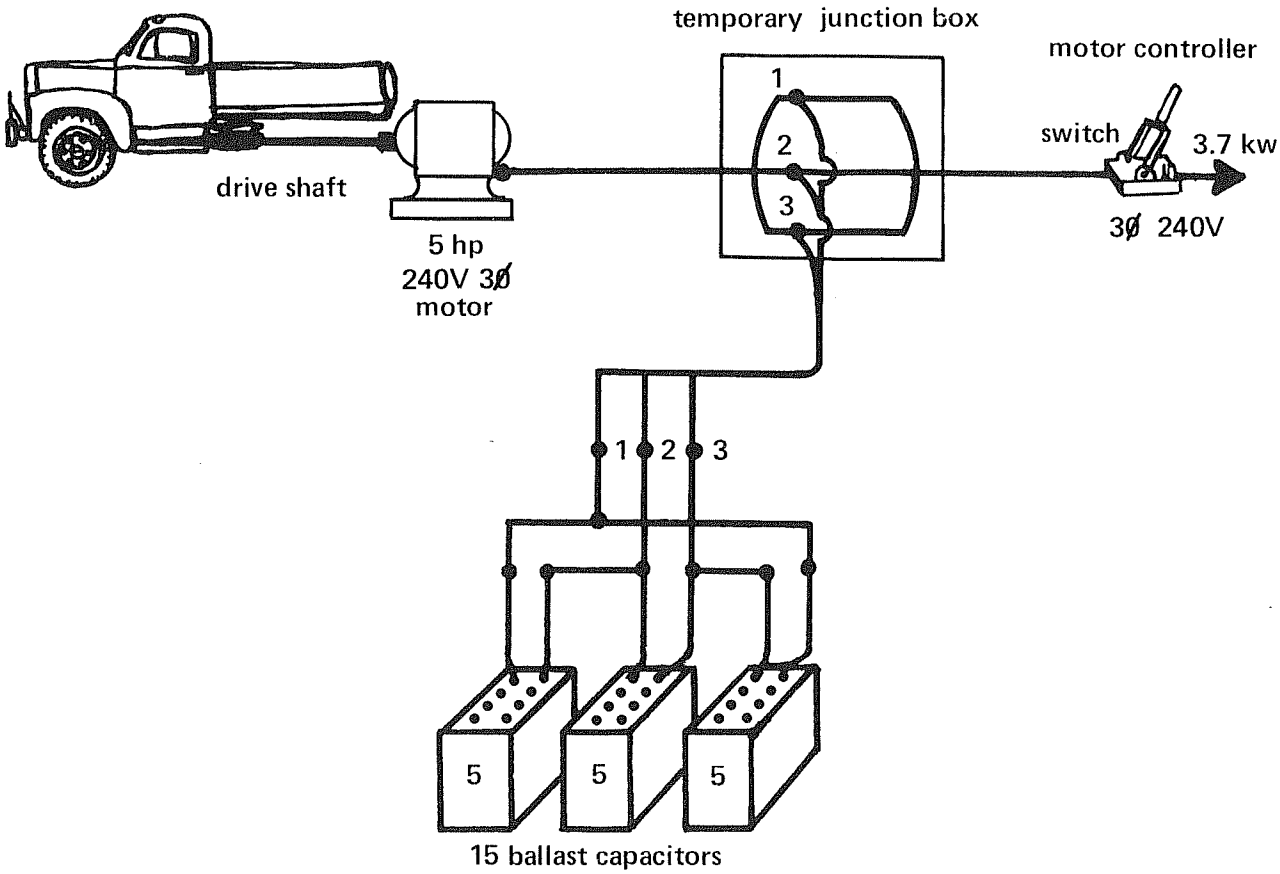
(1) **An induction motor** to be used as the generator. It should be about four times as large as the largest motor to be started. That is, a 5-hp pump motor needs a 20-hp induction generator to start it.

(2) **The prime mover** must be an internal-combustion engine about three times the generator's size. In other words, a 20-hp induction generator needs a 50 to 60 horsepower truck or tractor engine to drive it. An adjustable speed governor on the engine is most desirable. The engine can be coupled to the induction motor by belt drive from a rear wheel (upper sketch), directly from the drive shaft (lower sketch) or through the "power takeoff unit" with which many trucks and tractors are equipped.

(3) **A source of excitation,** usually a capacitor of about the same rating as the induction motor. Heavy-duty power capacitors are often used to improve "power factor" and thus can be found near large motors or near the distribution panel in many facilities. Another source of capacitors is the ballasts in fluorescent lighting units. The lower sketch shows a 5-hp induction generator excited by 15 capacitors from such ballasts. This generator will produce over 3.5 kilowatts of electric power.



EXPEDIENT INDUCTION GENERATORS*



*From Black, R.H., **Guidelines for Generating and Using Electric Power During Prolonged Emergencies**, URS Research Company, September 1971 (AD 739 945).

PANEL 14

EXPANDING PUBLIC SAFETY FORCES

Most regular public safety functions of local government must be resumed before the release of the general population from shelters after an attack. Outside of damaged areas, existing public safety forces should be sufficient to perform these functions in their normal manner, whenever fallout conditions permit the release of the sheltered population. However, if the normal population has been greatly increased by an influx of survivors from areas more severely affected, most of the regular public safety tasks will require longer work shifts, increased manpower, or both.

In addition, there will be many special public safety needs to be met. Most of these would impact on the police force, since they are normally associated with the peacetime law-and-order function. A large expansion in numbers of auxiliary police, guards, and watchmen would be necessary. These people would not need much training in most cases, but they would need to be selected and recruited and would need professional supervision. In many cases, professional peace officers would need to devote most of their time to supervision and training of a greatly-expanded public safety force.

Control of access into damaged areas and areas of fallout radiation should be planned. Control points would be needed on major access routes. Minor streets and roads should be blocked completely and posted with warning signs. Locations of special hazard because of concentrations of fallout or because of damage to buildings and structures would need barriers and warning signs. A program of demolition and correction of hazardous conditions should be planned. Finally, areas vacated during or before the attack should be patrolled, if and when feasible.

Another class of special needs arises from the requirement to control rigorously the use of critical resources. The most critical are food, fuel, and pharmaceuticals. Construction supplies, household supplies, and transport are also essential survival items. Guards and watchmen will be needed to prevent pilferage and unauthorized use. One means of minimizing opportunities for circumventing control of scarce resources is to limit unauthorized travel, especially vehicular travel. Requiring special identification for such movement will also conserve the limited fuel supply.

A specialized problem will also arise in directing the movement of incoming refugees, mutual aid teams, and supply transports to staging areas and warehouses with which they will be unfamiliar.

POST-SHELTER PUBLIC SAFETY NEEDS

REGULAR

1. Fighting Fires
2. Controlling Traffic
3. Investigating Crimes and Complaints
4. Responding to Accidents and Other Emergencies

SPECIAL

1. Controlling Access to Damaged Areas
2. Controlling Access to Fallout Areas
3. Marking Hazardous Areas
4. Correcting Hazardous Conditions
5. Patrolling Vacated Areas
6. Guarding Essential Resources
7. Preventing Unauthorized Travel
8. Directing Refugees and Aid Teams

REDEPLOYMENT

In preparing the defense, we must aim at readiness for all likely contingencies in every locality. For example, every locality should be prepared for fallout, with shelters, RADEF instruments, and people trained to use them. But we know, in reality, that some cities and counties are better prepared than others and are likely to remain so. In the post-shelter environment, we would know where the damage occurred and where the fallout was (see Panel 4). We saw in Panel 5 that some areas of the country would have negligible fallout while other areas, not too far distant, would have a persistent radiation threat. In areas of negligible fallout, trained RADEF personnel and instruments would not be needed. Their know-how would be invaluable in the fallout areas. What would be needed would be a redeployment of specialized personnel and equipment to areas of need.

This partial listing of valuable specialties emphasizes the point that "know-how" is the most important aspect of redeployment. The stricken areas would not be without resources but experience and knowledge may be in short supply. An extra shift of trained operators could permit the existing equipment to be worked around the clock. In most cases, the specialized equipment needed could be carried with the personnel.

Trucks and heavy construction equipment would necessarily move by road or rail. Most everything else could be brought in by air. Regular commercial aircraft generally have been earmarked for military support missions, but the Civil Air Patrol (CAP) and most private and corporate aircraft would be available for urgent recovery needs. Most States have SARDA plans for this purpose. (SARDA means State And Regional Defense Airlift.)

Local emergency plans should provide for assessment of the need for specialized help in the immediate post-shelter period. No locality should attempt to "go it alone" with inadequately trained advisors when making known deficiencies to the State would often bring help. Alternatively, for the lesser contingencies, plans should call for notifying the State of available skills and equipment that might be used in more severely affected jurisdictions. Only in this way can the State and Region "put it all together."

SKILLS AND EQUIPMENT NEEDED IN SOME AREAS MORE THAN IN OTHERS

1. Radiological Defense Officers, monitors, and radiation detection equipment.
2. Doctors, nurses, and medical people.
3. Utility repair crews and trucks.
4. Public health experts, exterminators, and supplies.
5. Leaders and planners, including experienced construction managers.
6. Bulldozers, cranes, loaders, and their operators
7. Skilled construction crews and tools.

RESTORING INDUSTRIAL PRODUCTION

Civil defense measures that would increase the short-run survival of the population in a nuclear war would be of little value if the war would so cripple the nation's economic system that the survivors could not be supported in the long run. In a sense, there would be a race between resumed production of essential survival items and the depletion of inventories from which essential needs were being met in the meantime. Whether the race could be won would depend on how long the inventories could last, how many factories survived, what kinds of things they could produce, whether damaged factories could be repaired or "cannibalized" to create new factories, and how long it would take to build new sources of supply.

Understanding the economic recovery problem is immensely complicated because of the interdependence of modern industry. An example is shown here. Suppose all of the economic activities that go to make up a modern industrialized society were lumped into 15 classes or "sectors" of economic activity. Then it would be found that each sector depended on goods and services obtained from all the other sectors in order to produce whatever that sector was intended to accomplish. For example, the Motor Vehicles sector, according to recent census figures, buys $1.39 worth of goods from the Food and Textiles sector for every $100 of motor vehicles made and sold. (Presumably this is for upholstery and the like.) A big supplier is Primary Metals—steel and aluminum. Another is Fabricated Metals. The biggest dependence is on parts suppliers within the Motor Vehicles sector itself. Altogether, the Motor Vehicles sector pays out about 70 percent of its gross sales to suppliers of goods and services. With what is left the Motor Vehicles "industry" has to pay its own employees. pay taxes, and make a profit.

What this means is that even if Detroit were spared in an attack, whether it could produce motor vehicles would depend on how much damage and destruction occurred in other sectors. The other sectors, in turn, are dependent upon their own suppliers, who are again dependent on the surviving sources of their supply. Thus, merely totting up how much of each industry survived will not tell how much can be produced by a post-shelter industrial base that has been damaged to various degrees in its many interlocking parts.

PURCHASES BY THE MOTOR VEHICLES SECTOR

SECTORS	Purchases Per $100 of Sales
1. Food and Textiles	$ 1.39
2. Wood and Paper	0.15
3. Chemicals	0.62
4. Petroleum Refining	0.17
5. Rubber and Leather	2.23
6. Stone, Clay, and Glass	1.12
7. Primary Metals	10.00
8. Fabricated Metals	6.33
9. Machinery, except Electrical	4.34
10. Electrical	2.15
11. Motor Vehicles	32.96
12. Aircraft and Transportation Equipment	0.09
13. Instruments and Optics	0.64
14. Trade and Services	5.13
15. Diffuse*	3.08
Total Intermediate Purchases	$ 70.40

*Includes Agriculture, Mining, Construction, Transportation, Utilities, and Imports.

ECONOMIC RECOVERY

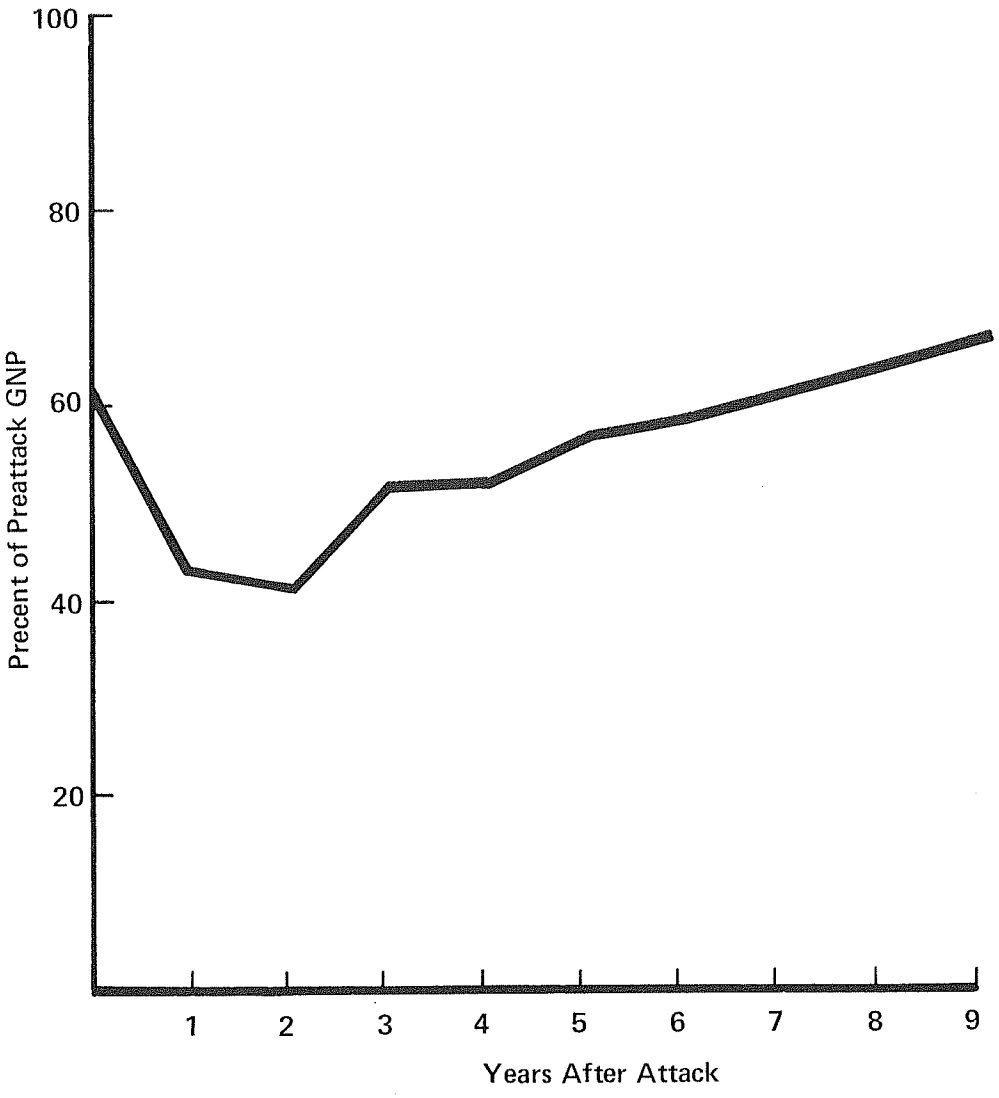
A measure of all the goods and services produced by the peacetime economy to satisfy the final purchasers is the Gross National Product (GNP). One way to judge the potential viability of the war-damaged economy is to compare its capability in terms of Gross National Product with the undamaged preattack GNP. To do this, the inter-industry transactions for each "sector" are established from census data (such as shown in the previous panel), damage to each sector is estimated for a given presumed attack, and the possible end-product production calculated on a computer. This is known as an "input-output" analysis; the results of one such analysis are shown here.

The computer model used in this analysis is based on the 15-sector economy shown in the previous panel. Final demand on the surviving industry is composed of consumption requirements of the population and investment in building new facilities to replace those lost in the attack. The model attempts to use the surviving capacity (limited by inter-industry requirements for intermediate products) as much as possible to meet consumption requirements and to allocate investment in critical sectors in such a way that the stream of GNP into the indefinite future is as great as possible. Investment of $2 in new construction was assumed to produce $1 of increased capacity two years later.

The results shown here are based upon an assumed attack in which, in addition to military and other targets, about one-third of the Soviet weapons shown in Chapter 1 are targeted to maximize damage to all economic sectors. The surviving capacity is estimated to be about 60 percent of the preattack GNP but limits on available resources further reduce production to about 40 percent of the preattack level at the end of the second year. Then, the investments made in the interim begin to pay off and the economy begins to grow. By the ninth year, the economy is estimated to be about two-thirds of the preattack level and growing at about 4 percent each year. (Note the similarity between this projection and that of Panel 2.)

Larger attacks would further limit the surviving industrial capacity. Also, an attack of the same magnitude that aimed at destroying a critical sector, such as petroleum refining, would leave much of the surviving capacity in other sectors unusable until substitute refining capacity could be developed. Thereafter, there would be a very rapid increase in overall production. Finally, the lumping of production facilities into a relatively few economic sectors assumes that the products are readily substituted for each other or that the facilities can be readily converted. This is not always the case. So most analyses use 80 or more sectors. These analyses predict economic viability over a wide range of size and kind of nuclear attack.

ONE PROJECTION OF ECONOMIC RECOVERY*



*From Dresch, F.W., and Baum, S., **Analysis of the U.S. and USSR Potential for Economic Recovery Following a Nuclear Attack,** Stanford Research Institute, October 1972 (AD 755 552).

EARLY PRODUCTION PROBLEMS

Economic models, such as that described in the previous panel, estimate what is physically capable of being done with the available productive resources if these resources are used efficiently to achieve some stated goal. In peacetime, those who have immediate control over productive resources tend to use them in ways each thinks will maximize his private gain. In a "free enterprise" economy, this is also considered to be in the national interest. In postattack recovery analyses, it is assumed that what people do with the resources over which they have immediate control will be determined for them by general rules and specific orders that fit a national recovery plan.

It seems most likely that, for at least the first few months after a nuclear attack, national authorities would lack the information, staff, and experience to be able to do much central management of the economy. Therefore, official planning provides for a set of prepositioned regulations that become effective upon attack and that (1) delegate Federal authority to heads of regional offices of the Federal Government and to State and local authorities, and (2) freeze prices, wages, and rents, institute consumer rationing, and establish a priority system. Federal authorities have made up a list of survival items (mostly medical, food, shelter, and fuel) that would be attached to the proclamation of the priority system by the State Governor or his legal successor. These excerpts are from the proclamation that appears in virtually all State plans. Each producer of an item on the priority list need merely certify on his orders that the supplies are needed for production of the priority goods. Local heads of government will be directed to initiate the controls. It is expected producers and suppliers, impressed with the gravity of the emergency, will comply with the published rules without need for extensive surveillance.

Associated with the price and wage-rate freezes will be a freeze on interest rates. At these rates, there will be unlimited credit from banks, backed by the Federal Reserve System, for priority activities. Most other bank deposits would be frozen for the time being.

It is reasonable to expect that sometimes there will be insufficient supplies to satisfy all priority orders and other important needs. Federal regional offices, State Resource Priority Boards, and State departments will assist in adjudicating these problems. But the emergency planner should recognize that the local government is expected to play a key role during the immediate post-shelter period in assuring that resources are carefully conserved and channeled into the most urgent uses and activities.

EXCERPTS FROM GOVERNOR'S PROCLAMATION*

To: Executive Heads of All Political Subdivisions in this State

I hereby proclaim these policies and guidance in effect throughout this State . . .

Facilities in your jurisdiction which produce or distribute items or provide services essential for local, State, and National survival . . . have been identified . . .

You are requested to authorize essential local users . . . to use the following certification on their purchase orders . . .

Please advise local employment offices to act . . .

You are to inform secondary suppliers of essential survival items in your jurisdictions that they are prohibited . . .

If supplies of essential survival items available . . . are inadequate, you are to restrict further their use to those needs which, in your judgment, are most urgent . . . and request . . . resupply to make up local deficiencies.

You are to inform persons engaged in essential local activities or operating essential facilities how to obtain emergency credit . . .

As soon as possible, you are requested to arrange for rationing of designated essential consumer items.

Governor

*From **Example of a State Plan for Emergency Management of Resources,** Executive Office of the President, September 1965.

CRISIS ACTIONS FOR ECONOMIC RECOVERY

A period of extreme crisis could provide both the time and the sense of urgency that would be necessary for taking action to improve the prospects for postattack economic recovery. Local government, working cooperatively with local industry, could make the essential peacetime plans without which the task of implementing crisis actions would be much more difficult. Mobilization during times of international tension is compatible with current estimates of a low probability of sudden attack (see Chapter 1).

Many major corporations have made peacetime arrangements for protected alternate corporate headquarters. In a crisis, most other businesses could relocate essential records and management personnel outside the large cities. Management will recognize such plans as insurance that they can "stay in business."

Hundreds of billions of dollars of economic assets are located in potential target areas in the form of finished inventories, parts, and specialized equipment. In a crisis, many of these resources could be loaded on trucks, railroad cars, and delivery vehicles and removed from the area where they could be placed in temporary open storage or parked in the loaded vehicles. Equipment and parts needed to sustain production, should this be necessary, could be buried later on the premises to protect them against blast and heat damage. This could be done in a few hours' time in many instances. Delicate and irreplaceable control equipment should be wrapped in plastic before burial. Machine tools and bulky equipment that cannot be moved can be made less vulnerable to damage by sandbagging and other protective measures so that they could be recovered even if the building is demolished. A large proportion of business assets could be preserved with the use of these measures.

Facilities outside the cities for bulk storage of fuels, chemicals, grains and other essential commodities could be brought at full capacity despite seasonal demands. As noted in the next panel, fuel, fertilizers, and pesticides will be of particular importance in assuring early recovery of agricultural production. Needless to say, expedient fallout shelter should be planned for at industrial and supply facilities that are intended for continued operation or for early postattack use.

Finally, government can contribute to early economic recovery by offering RADEF equipment and crisis training and by preparing plans and materials for implementing rationing and other control measures.

CRISIS PREPARATIONS*

- Remove records and management to safer locations.
- Relocate valuable equipment and inventories.
- Bury critical movable items.
- Protect machine tools and special equipment.
- Augment inventories of fuel, chemicals, and other stocks outside urban areas.
- Accelerate production and safe stockpiling of essential survival items.
- Provide shelter and alternate locations for work force and dependents.
- Expand RADEF capabilities outside urban areas.
- Mobilize postattack control measures.

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*Based in part on Rockett, F.C., and Brown, W.M., **Crisis Preparations for Postattack Economic Recovery,** Hudson Institute, July 1966 (AD 639 387).

AGRICULTURAL PRODUCTION

In his major study, **Economic Viability After Thermonuclear War: The Limits of Feasible Production,** Rand economist Sidney G. Winter, Jr., came to this conclusion: "If measures could be devised and preparations made to assure that agriculture would not be drastically altered, then it appears that all other economic problems could be managed." Dr. Winter was considering attacks of the size that could now be delivered at a time when lack of knowledge about fallout created a grave uncertainty as to how much farmland would remain suitable for growing crops. As discussed in Chapter 6, this is no longer believed to represent a serious problem. Nonetheless, recovery of agriculture remains crucial to post-attack viability.

In the United States, less than 5 percent of the population produces peacetime surpluses on a fraction of the arable land. This means that agriculture is dependent on other sectors of the economy to support its mechanized and intensive operations. The most critical needs are fuel and fertilizer. Without petroleum products, field crop production would be virtually impossible. All major food and feed crops are mechanically planted and harvested. Livestock, which accounts for nearly half the caloric value of the food produced, depends on the availability of feed, which is itself dependent on petroleum. The petroleum refining industry, which is highly concentrated, is potentially vulnerable. However, the use of farm machinery is seasonal and petroleum storage on or near farms is substantial. Post-attack, a greater share of the surviving fuel could be directed to agriculture and plans should be made to allocate petroleum to those areas where immediate use of machinery is essential and where high yields are to be expected.

It has been estimated that about one half of U.S. food production can be attributed to applied fertilizers. Lack of fertilizers can be accommodated partially by emphasizing crops and farm regions not requiring fertilizer and by bringing more land under cultivation. The latter course, however, requires more fuel. Nitrogen is the principal nutrient required. Nitrogen production facilities are located throughout the country and considerable excess capacity exists today. Sufficient production is expected to survive a major nuclear attack.

Major field crops are grown without pesticides in many places. Lack of pesticide availability would be most strongly felt in the yields of potatoes, fruits, and vegetables. Irrigation is also important for these crops, as well as for rice and sugar beets. Availability of electricity is most critical to dairy and poultry production.

Studies have shown that capabilities for transportation, storage, and food processing of basic agricultural commodities should survive as well or better than food production, except for wholesale warehousing. Good management, based on adequate plans, appears to be the key to recovery of food production.

CRITICAL NEEDS FOR FOOD PRODUCTION*

- Fuel and Lubricants
- Fertilizer
- Pesticides
- Seeds
- Irrigation and Drinking Water
- Equipment and Parts
- Feed
- Electricity
- Transportation, Storage, and Processing

*From Brown, S.L., et al., **Agricultural Vulnerability to Nuclear War,** Stanford Research Institute, February 1973. (AD 765 725)

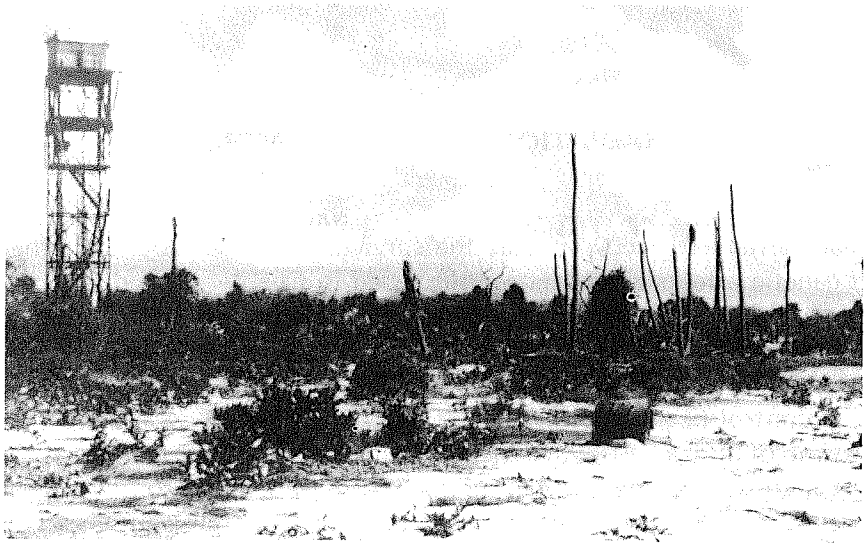
ECOLOGICAL DEFENSE

In Chapter 6, Panel 28, the possibilities of ecological catastrophe were discussed. Speculation that the attack environment might cause drastic upsets in the "balance of nature" have assumed that changes that exist for a relatively short time can induce permanent ecological damage. This is not borne out by experience. For example, some of the atolls in the South Pacific have experienced repeated direct effects and fallout from weapons tests comparable to the worst that could occur in a nuclear war. As these illustrations show, the tropical ecosystem has survived and recovered. The native population has returned to live on Bikini and Rongelap Atolls. Long-term consequences require continuous pressure over centuries of time, of which the impact of human habitation is the outstanding example.

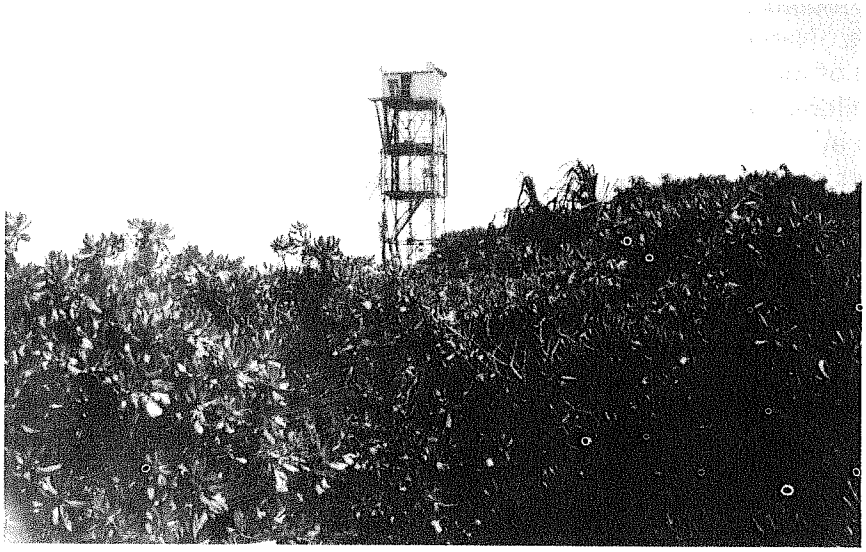
Some significant consequences that may well occur as part of the post-shelter environment are also discussed in Chapter 6. These potential ecological consequences (one cooler growing season, temporarily increased rainfall, fire in dead pine forests, increased erosion and silting, and outbreaks of insect and rodent pests) could have an indirect effect on agriculture and forestry.

Trees, especially pines, are vulnerable to fallout radiation. The loss of a forest can be regained only after many decades. Dead trees are a valuable resource for wood products if they are harvested. If not harvested, they become a refuge for insect pests and plant diseases. They become a fire hazard. Forest fires destroy both trees and ground litter, resulting in increased surface runoff and erosion, excessive silting of streams, reservoirs, and irrigation works, loss of water for crops, and loss of crop yield. Prompt harvesting and reforestation are postattack actions needed to control these consequences.

Fallout radiation effects on insects and wild animals could affect agricultural production. For example, bees are essential to the pollination of certain agricultural crops, particularly fruits. A large reduction in the natural population of birds and preying insects could produce severe crop infestation by parasitic insects. But man is not helpless. He can move bee colonies where they are needed. He can import or otherwise assist the repopulation of fallout areas with beneficial species. All of these actions could well be called, "ecological defense."



Bikini Island, November 1955



View of same area as above in 1967. Some coconut trees had reached 20 feet and were bearing fruit.

RADIATION EXPOSURE CONTROL

The final barriers to recovery that the survivors must surmount are the possible late somatic and genetic effects of irradiation discussed in Chapters 5 and 6. The key to these problems is good radiation exposure control. Exposure control in the post-shelter environment will be greatly aided by the advice of trained Radiological Defense Officers.

Exposure control begins, however, with effective warning and sheltering of the population at the time of attack. Effective sheltering involves the use of the **best** available fallout shelter, not just those that meet some minimum criterion, such as PF 40. That is, the planner must be concerned not only with preventing lethal exposures but also with keeping the radiation **burden** of the survivors as low as possible. To this end, a protection factor of 400 is vastly better than a protection factor of 40. Crisis plans to build expedient shelters (Chapter 7) and to improve the protection in existing shelter areas can contribute to exposure control.

People should be encouraged and instructed to remain in shelter as long as possible in fallout areas. Naturally, this advice must be balanced against the need to get on with the urgent tasks of recovery. But many, especially children, are not needed for these early tasks outside. Children and young adults should be given maximum protection to minimize genetic damage in subsequent generations. Late radiation injury is of minimal concern to those over 40 years of age. Even so, the shelter areas should be used as off-duty quarters for the workers.

An important control measure during the first month after attack will be to limit the intake of radioactive iodine by children (see Chapter 6, Panel 25). They should be provided with stocked water or water from wells or areas of low contamination and kept from drinking contaminated milk.

Even in areas of moderate fallout, decontamination will be important to limit the continued exposure to radiation over the months and years ahead. In the process, the necessary radiation exposure should be spread among the able-bodied survivors by rotation and work shifts so that the radiation burden of individuals is kept as low as possible.

ELEMENTS OF EXPOSURE CONTROL

- Make sure there is a RADEF person on the staff who is well-trained and qualified.
- Make use of best available fallout shelter.
- Keep the population in shelter as long as possible.
- Preferentially protect children and young adults.
- Use shelters for lodging after "shelter emergence."
- Provide children with uncontaminated drinking water for the first month.
- Decontaminate living and working areas.
- Spread the necessary radiation exposure among the work force.
- Keep on decontaminating.

MOTIVATING THE SURVIVORS

In Chapter 7, Panel 24, some points are made about human behavior in disaster. We can expect the survivors' motivations to be dominated by concern for the safety of self and family from the time they believe an attack is imminent until they understand the attack to be over. After the attack is over, survivors would try to learn of the fate of separated family members and would seek information about the national and local situations. One can expect most behavior to focus on the problem of supplying the basic needs for food, water, and shelter for the family.

Individual and small group foraging and hoarding of found supplies consume available resources and do nothing to bring about future resupply. A significant implication for planning is that means must be found for satisfying the survivors' basic needs while, at the same time, motivating and directing the efforts of survivors in other critical recovery activities. Most students of this problem believe that local authorities should take charge of all critical supplies in order to satisfy equitably the subsistence needs of the survivors, to eliminate competing ways of meeting these needs, and to provide meaningful rewards for productive work in critical recovery activities. The survivors are apt to welcome positive action of this kind and are likely to place a high social value on opportunities to participate in activities clearly associated with improving personal and national well-being. The recovery management precepts recommended by one of the knowledgeable research groups on this subject are presented in this listing.

One observation from disaster research is that communities of survivors tend to develop strong bonds of solidarity and to look for guidance and support to the leaders who have brought them through difficulties. After nuclear attack, the most immediate and acceptable authority structure is that which developed during the shelter stay. This suggests that a good plan is to continue the shelter organization into the post-shelter environment, rather than allowing it to dissolve while attempting to build a wholly new organization to provide for the subsistence needs of the survivors. Emergent shelter leaders should be welcomed into the "official" organization and encouraged to continue to care for and represent the groups in their charge.

RECOVERY MANAGEMENT PRECEPTS*

1. Exercise strict control over existing supplies of food, housing, and other critical supplies and provide security for these supplies of goods.
2. Satisfy the subsistence needs of the survivors so as to release manpower for participation in critical recovery activities.
3. Reward work in critical recovery activities (in a way that is linked to increased distribution of goods to the worker's family).
4. Perpetuate family and group solidarity and leadership developed in shelter into the post-shelter period.
5. Communicate survival and recovery goals and foster expectations of improvement in well-being as goals are achieved.
6. Publicize plans for insuring continued ownership of private property, for relieving, at least temporarily, individuals of pre-attack economic obligations, and for providing some degree of restitution for losses when national production affords a surplus.
7. Establish recovery management under the auspices of the highest constitutional authorities, oversee its performance by elected representatives at all levels, and plan for return to political and social institutions acceptable to the survivors as soon as feasible.

*Based on Chenault, W.W., and Nordlie, P.G., **Consumer Behavior and Worker Participation in Recovery Activities,** Human Sciences Research, Inc., February 1967 (AD 651 098).

RE-ESTABLISHING INSTITUTIONS

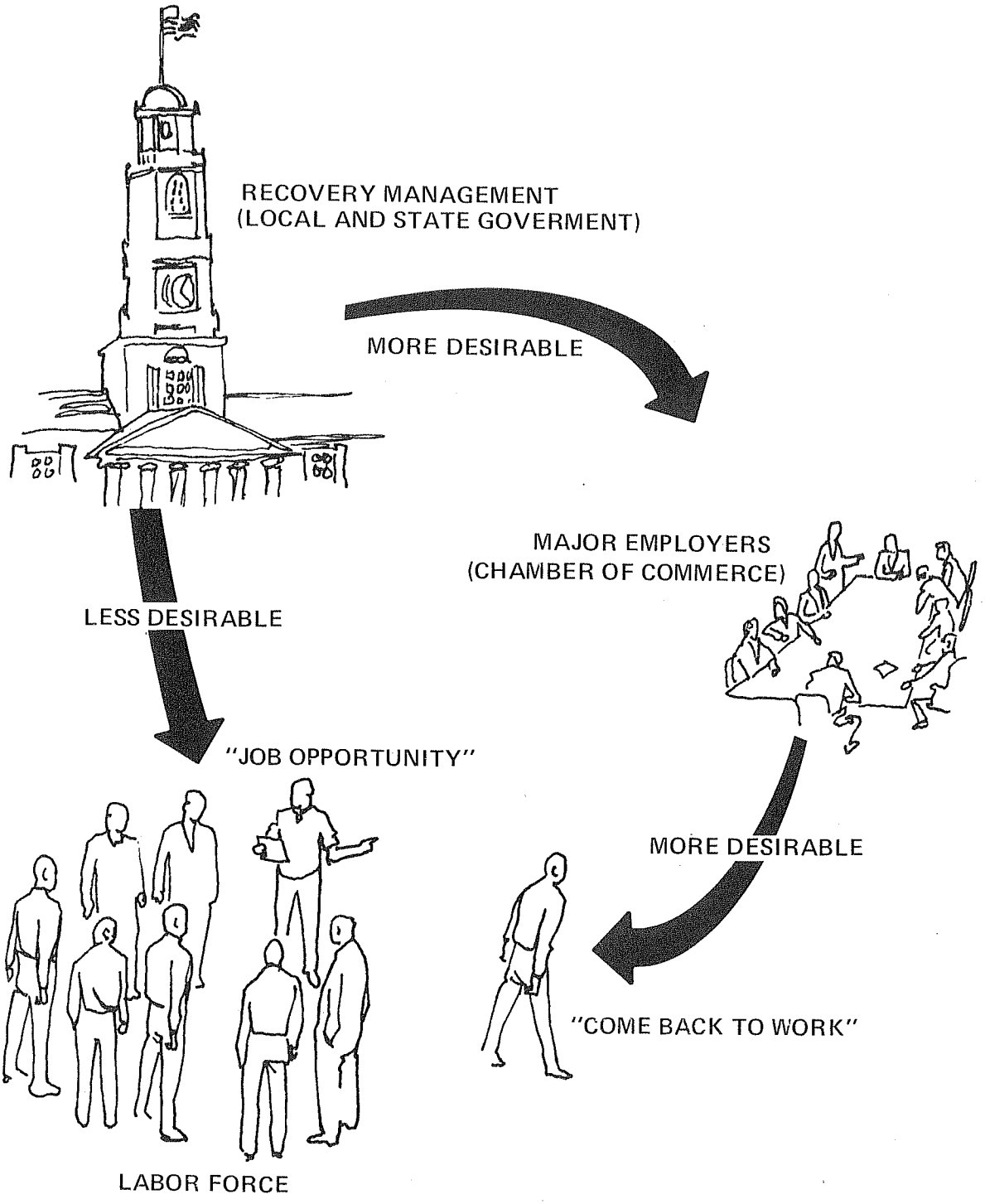
During most peacetime disasters, certain organizational activities cease to be important —an industrial plant may be closed for the duration—while the worker often is expected to engage in "emergency" or unusual activities. He may help rescue victims or care for refugees. He and his family may use different lodgings, supermarkets, or stores. But these changes are usually temporary. When things "return to normal," most affected people are once more performing work and consumer activities that closely approximate their pre-disaster routines of living. In sum, the disaster is over when most organizations (and therefore their employees) again are operating as part of larger networks of organizations and institutions.

In contrast to peacetime disaster, a widespread nuclear attack will damage the entire system of interlocking organizations. Post-shelter relationships often will not be the same as before the attack. In other words, there will be less of a "normal" pattern to return to.

The emergency planner should understand that most family heads and, hence, families, "anchor" their daily lives around their job affiliations. In many respects, anticipating a "return to normal" means resuming the pre-disaster work affiliation. And this job affiliation is also the principal link between the individual and the organized distribution of work activities throughout the economy. After all, an early goal in postattack recovery management must be to reconstitute a routine procedure by which goods and services are produced, distributed, and exchanged. One means of achieving this goal is to emphasize organizational continuity during crisis and emergency periods.

A working organization can remain reasonably "intact" for a while even if it is not functioning. If damage assessment and planning eventually indicate that the organization has no place in the post-shelter world, then employees can be systematically placed in similar work elsewhere. One should plan in the interim to maintain the communications link with the individual worker through his preattack work organization. Preserving the integrity of economic organizations—all of them, not just critical industries—is probably the most efficient approach to organizing the postwar labor force. The alternative—allowing people to lose their work identity and hiring more or less anonymous "workers" through employment agencies—is likely to make more difficult the psychological process of "returning to normal."

LABOR : EMPLOYED OR UNEMPLOYED



PANEL 25

POST-SHELTER PROBLEMS IN DAMAGED AREAS

The information in Chapter 8 to this point is broadly applicable to all nuclear emergency planning. In addition, there are some recovery operations that are peculiar to damaged areas. The next four panels deal with these operations.

The immediate survival needs at the time of initial shelter emergence will be water, food, and accommodations. As radiation levels decline to levels permitting outside operations, the first step will be to establish a number of "staging areas" as bases from which to conduct early operations and to which can be brought aid from the nearby undamaged areas. (The idea of using a staging area was first discussed in Chapter 2, Panel 29.)

Routes would need to be cleared through the debris to permit vehicular access from the staging areas to the undamaged region, to the shelters where survivors are located, and to water, sewage, and power facilities.

Water, food, and medical aid may need to be provided to the sheltered population prior to the time that they could be relocated. At the appropriate time, survivors would be brought to the staging areas where buses would move the homeless to housing in the light-damage and undamaged areas.

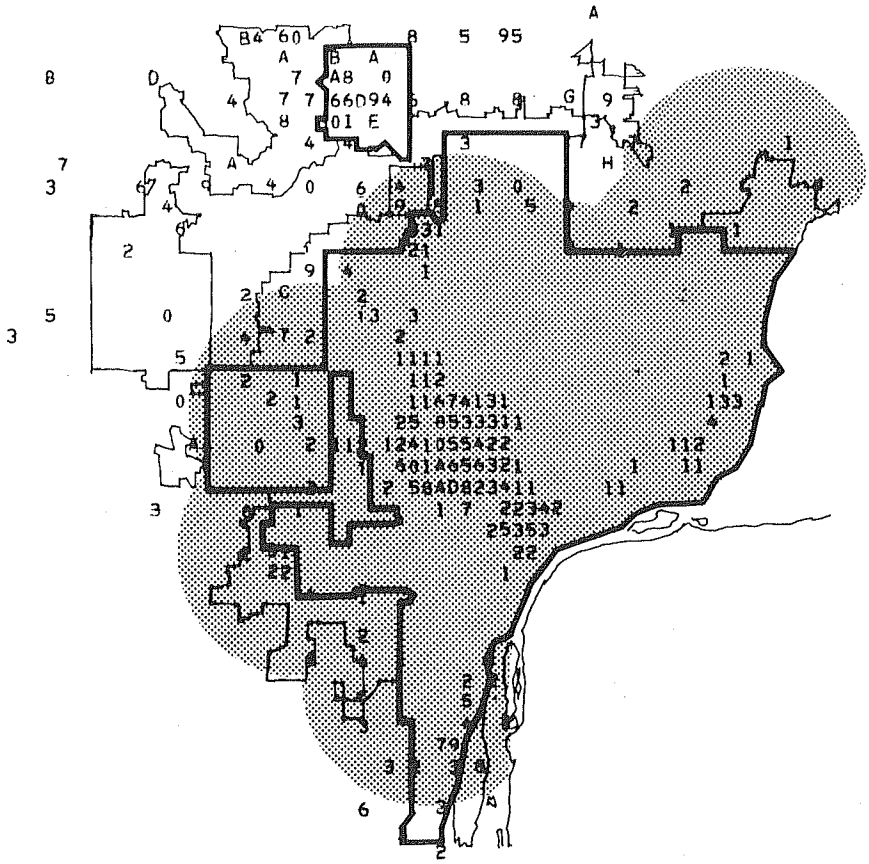
Housing experiencing in excess of about 3-psi blast overpressure generally would not be repairable for habitation. The areas in Detroit where housing would be lacking are shown here for the same heavy attack presented in Chapter 1, Panel 12. Outside these areas, housing may need decontamination and some repairs. Utility services may also need restoration. In cold weather, broken windows would need to be covered throughout the metropolitan area.

Vital facilities would need repairs if such would permit early return to operation. Surviving equipment and materials in more heavily damaged utility and industrial facilities would need to be protected from further damage until they could be removed for use elsewhere.

Studies have been made that show that these initial post-shelter recovery activities are feasible to complete in about one week, using surviving equipment and a fraction of the able-bodied male survivors.

SURVIVORS WITHOUT HOUSING*

(15 - 5MT WEAPONS ON UNWARNED NIGHTTIME POPULATION)



*See Chapter 1 for attack description

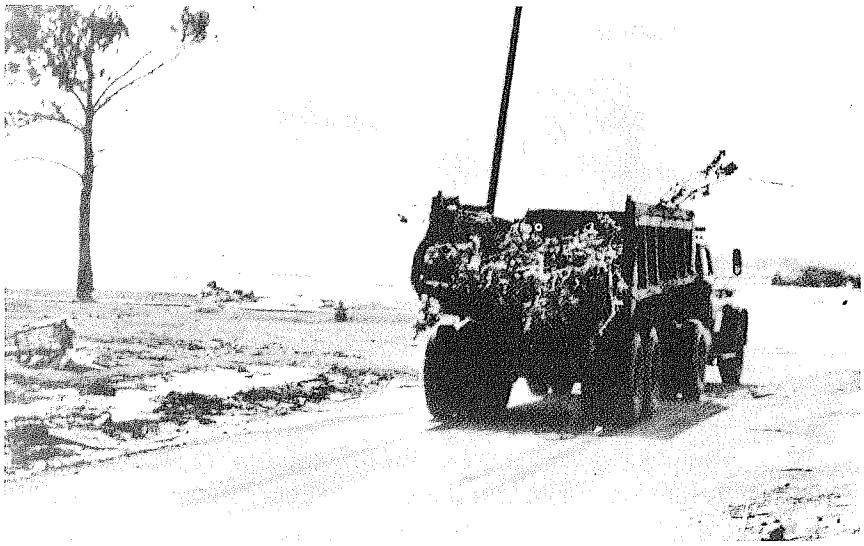
PANEL 26

DEBRIS CLEARANCE

Clearing of debris is a common activity required after most natural disasters. In the aftermath of such disasters, contracts are let with private construction firms who set to work cleaning up the mess, drawing equipment and equipment operators from as wide an area as is necessary for the job. Some inefficiency can be tolerated because of the abundance of resources. The photograph, from Hurricane Camille, shows a truck loaded about one-quarter full, partly because the tailgate has been removed to ease the dumping process, Chunks of debris drop off the trucks en route to the dumping site, where, because of inadequate organization, they often wait in line to dispose of their loads.

Debris clearance after nuclear attack can draw on peacetime experience but research has indicated that efficient use of surviving construction equipment and manpower will be necessary if essential clearance is to be accomplished in a timely manner. Construction trade officials (Associated General Contractors of America) have recognized this need and have prepared "Plan Bulldozer" as an aid to local government. This plan is designed to mobilize construction contractors to furnish materials, operate equipment, and supply skilled personnel as long as necessary under the direction of civil or military authority in event of natural disaster or nuclear attack.

As noted in Chapter 2, debris created by a nuclear detonation is expected to be distributed off-site where it will block access by wheeled vehicles. Clearance of streets will be a major post-shelter task upon which most other activity will depend. Pre-attack estimates of probable debris conditions, supported by post-attack reconnaissance, are needed so that proper groups of equipment can be assembled to handle the task. The nature of the task, and, hence, the equipment required, depends on the size and content of the debris chunks, the general depth of debris, the extent to which automobiles, trees, and utility poles are included in the debris, the width of road to be cleared, and similar factors. These factors have been analyzed into a limited number of basic tasks, for each of which appropriate "equipment groups" have been defined. A typical equipment group is summarized in the lower chart. This group is designed to clear light structural debris, which may include chunks up to 30 inches in size. The group can clear 1000 feet per 24-hour day of 50-foot roadway through debris five feet deep. Similar information is contained in the reference below the chart. The equipment codes shown are those set up in Plan Bulldozer.



*From Black, R.H., **The Effects of Hurricane Camille on Industry, Public Utilities, and Public Works Operations,** URS Research Co., March 1970 (AD 708 568).

TYPICAL EQUIPMENT GROUP*

1 Crawler-type Bulldozer, 250-300 H. P. (Code 286)

1 Front-End Loader (Side Dump) (Code 174)

2 Dump Trucks, 10 - 15 cu. yd. (Code 313)

1 Night Lighting Equipment (Code 602)

1 Tools and Supplies (Codes 620 and 621)

Supporting Resources Needed: Availability of fuel and lube truck (about 40 gal. of diesel fuel per hour), repair truck, equipment operators, and 2 unskilled laborers per shift.

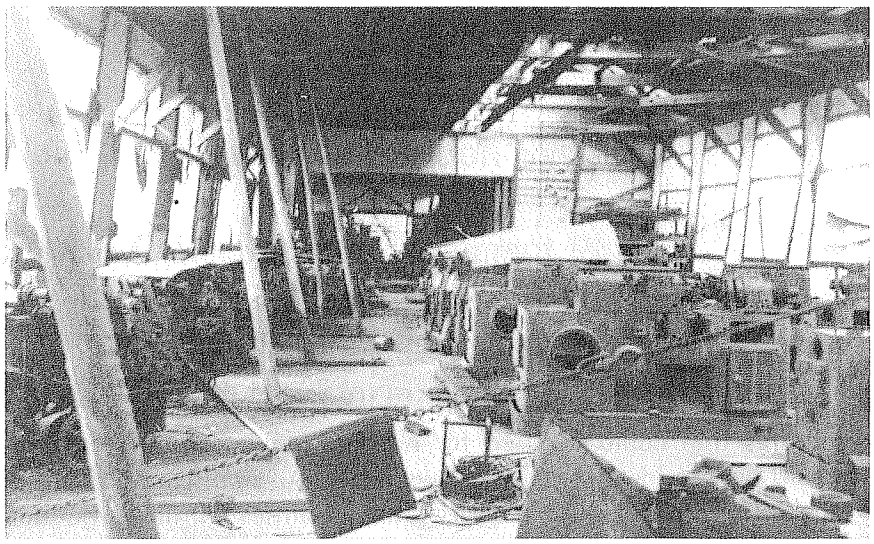
*Based on Wickham, G.E., **Debris Removal Civil Defense Operations,** Jacobs Associates, March 1969 (AD 693 885).

ASSET PRESERVATION AND SALVAGE

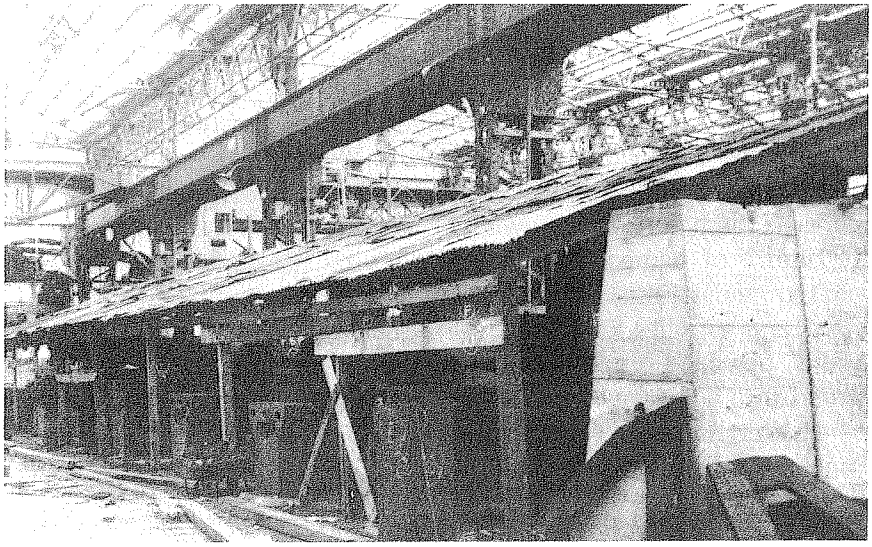
Most production equipment and supplies are much more resistant to blast damage than the buildings that house them. For example, heavy-duty machine tools have survived over 10-psi blast overpressure during weapons tests. Sandbagging or other protection, as suggested in Panel 20, will further improve survival possibilities. Subsequent fire can warp and melt delicate parts, as well as remove grease and paint so that corrosion can occur. Corrosion and rusting of neglected assets caused much damage at Hiroshima and Nagasaki. On the other hand, much damage was avoided by protective actions taken during the first few weeks after the detonations.

The upper photograph shows a wood-frame machine shop with windows and roof damaged by blast. The machine tools are essentially undamaged. Sheets of corrugated iron have been placed on some of the machines to protect them from the weather. The lower photograph shows a more advanced form of weather protection in a Nagasaki industrial plant.

As soon as feasible after shelter emergence, work parties should be formed from employees of commercial and industrial concerns in the damaged area. These teams should conduct an assessment of damage at each work site to determine whether the facility is operable or can be repaired. Surviving equipment should be coated with grease (usually available on the site) and covered by tarpaulins or sheets of stripped roofing. Supplies may be removed for immediate use or preserved on site, depending upon their nature. Salvage of usable equipment and supplies will probably be appropriate in residential areas as well. There will be a need for surviving beds, mattresses and bedding, canned goods, cooking utensils, water containers, and the like.



Undamaged machine tools at Hiroshima. Sheet metal is being used to protect against weathering.



Arrangement of temporary weather protection in Nagasaki industrial plant.

EMERGENCY REPAIRS

Assessment of damage to buildings and equipment in blast areas should be limited initially to structures that could be used for housing and to "vital facilities." A list of facilities that could be considered vital is shown here. An implication for emergency planning is that each jurisdiction should identify those facilities within its boundaries such as those on this list and should establish emergency planning and operating relationships with managers of those facilities under private ownership.

Damage assessment should be accomplished by plant engineers and operators who are knowledgeable of the facility. Decisions will usually have to be made as to whether the facility can be repaired or whether salvage of usable equipment and supplies is preferable. Repair requirements will need to be estimated. Generally, this assessment will be feasible in over 90 percent of the damaged area by the second week after attack.

As noted in Chapter 1, Congress has included in the definition of "civil defense," all activities and measures designed or undertaken to effectuate emergency repairs to, or the emergency restoration of, vital utilities and facilities. To assist emergency planners in preparing to undertake these actions following an attack, DCPA has conducted research to define the likely nature of damage to most of the vital facilities on the list, the best repair procedures and strategies, and estimates of repair requirements in terms of manpower, skills, equipment and supplies, and time. One such study, **Civil Defense Aspects of Water Works Operations**, has been republished and widely distributed. Results from others have been incorporated into a variety of industrial preparedness manuals prepared in cooperation with the Departments of Commerce and Interior. Some of the most useful research reports are listed in Panel 31, Suggested Additional Reading.

VITAL FACILITIES

- Water Works and Distribution Systems.
- Sewage Collection and Treatment Plants.
- Electric Power Distribution Facilities, including substations, transformers, and switching stations.
- Telephone System.
- Public Safety Radio Transmitters.
- Petroleum Refineries and Pipelines
- Natural Gas Production and Distribution.
- Pharmaceutical and Vaccine Plants.
- Food Processing Plants, especially grain mills and canneries, Food Container Factories, and Warehouses.
- Chemical Plants, especially producers of fertilizer, insecticides, and disinfectants.
- Plants Producing Other Survival Items.
- Defense Production Plants.
- Air, Rail, Truck, and Water Transportation Facilities.

SUMMARY

Prediction of the aftermath of a nuclear conflict—a war that has never occurred—is an enormously difficult task. Nonetheless, the areas of uncertainty gradually are being reduced. In addition to hundreds of individual research reports on specific aspects, there has been a number of major studies of national viability following nuclear attack. Those for which results have been summarized in the open literature are shown here. Several more have been classified for security reasons.

The significant point can be made that all of these major studies are highly affirmative as to whether the surviving physical and human resources are sufficient to permit a meaningful recovery. Indeed, they indicate that, if by some magic we could prevent all loss of life, the basic wherewithal for continued survival of the entire population and ultimate recovery would exist. It is not true that one could save too many. On the other hand, these studies attempt to evaluate the physical aspects of postattack viability only. They do not predict that the economy will be managed well, that people will behave in a constructive way, or that confidence would be maintained in the monetary system. It is likely that survivors would behave constructively and that the numerous management problems could be solved if reasonable plans are laid to give the public leadership, information, reassurance, and instructions and if preparations are made to carry out the tasks that seem necessary.

As with initial survival itself, much of the planning and preparations for coping with the post-shelter environment must be done in the local jurisdiction. In other words, if you, the emergency planner, do your job well, the survivors need not "envy the dead."

POSTNUCLEAR ATTACK STUDIES

STUDY	YEAR	FOR	ESTIMATED LOSSES	
			POPULATION	INDUSTRY
The Rand Study	1958	USAF	35%	55%
The SRI Study	1963	DoD	42%	45%
PAVUS-75	1967	Army	45%	35%
DAL-67	1967	DoD	45%	42%
PONAST II	1973	JCS	46%* / 11%**	63%

* With present civil preparedness capability.
** With crisis relocation and expedient fallout shelter.

SUGGESTED ADDITIONAL READING

Proceedings of the 1967 Symposium on Postattack Recovery from Nuclear War, National Academy of Sciences, April 1968. (AD 672 770)

Goen, R.L., **The Magnitude of Initial Postattack Recovery Activities**, Stanford Research Institute, December 1971. (AD 741 389)

Bensen, D.W., and Sparrow, A.H., **Survival of Food Crops and Livestock in the Event of Nuclear War**, U.S. Atomic Energy Commission, December 1971. (CONF 700-909)

Van Horn, W.H., et al., **Repair and Reclamation of Gas and Electric Utility Systems**, URS Research Co., July 1967. (AD 665 307)

Walker, F.E., **Estimating Production and Repair Effort in Blast-Damaged Petroleum Refineries**, Stanford Research Institute, July 1969. (AD 697 717)

Staackmann, M., et al., **Damage to the Drug Industry from Nuclear Attack and Resulting Requirements for Repair and Reclamation**, URS Research Co., July 1970. (AD 714 304)

Fernald, O.H., **Critical Industry Repair Analysis, Food Industry**, Advance Research, Inc., April 1965. (AD 614 908)

Pyecha, J.N., et al., **Postattack Medical Care Measures of Effectiveness**, Research Triangle Institute, September 1971. (AD 730 945)

PHOENIX RISING FROM THE ASHES

PANEL 31